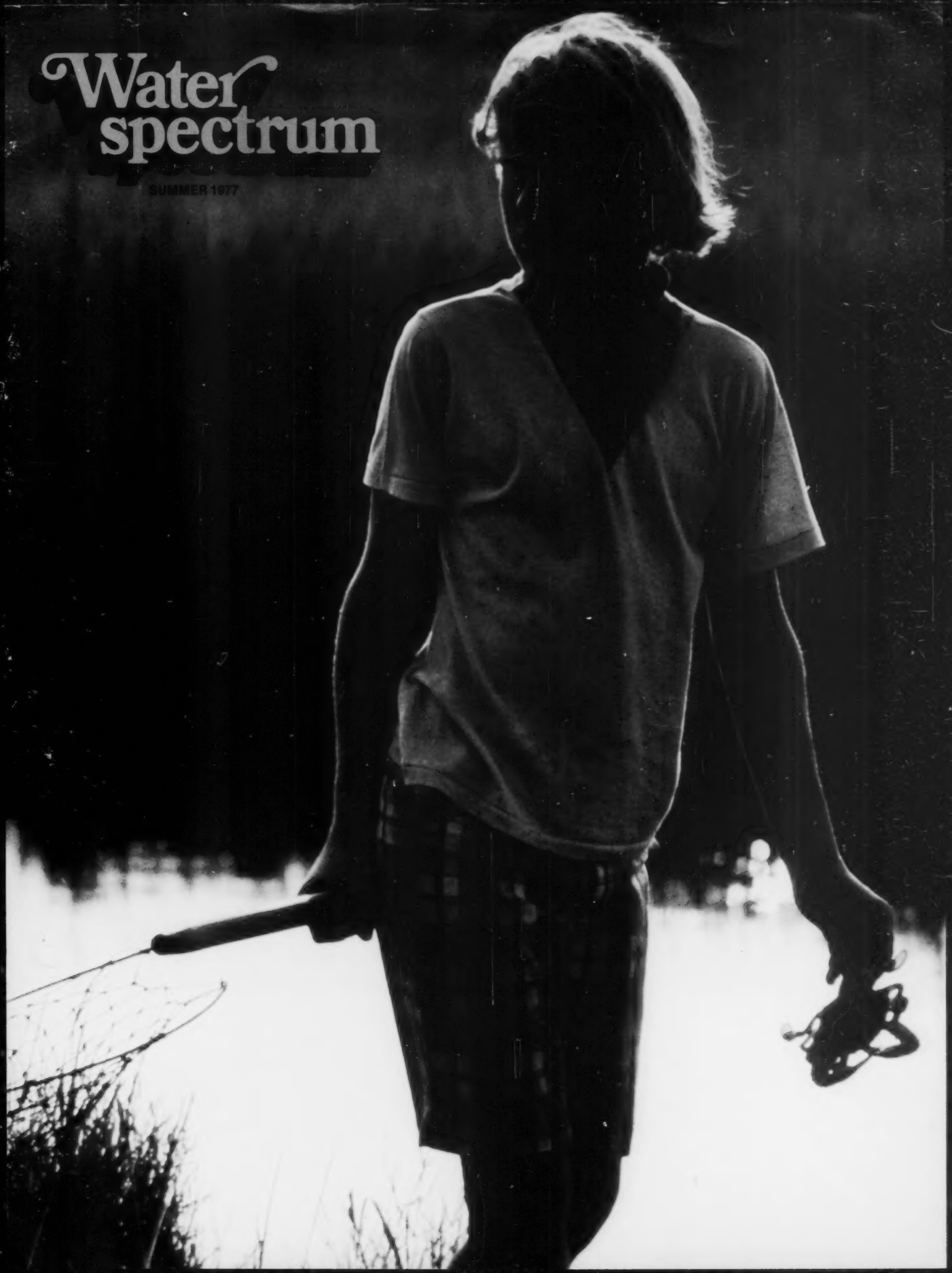
Water spectrum

SUMMER 1977



Water spectrum

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Editor, Water Spectrum
Office, Chief of Engineers
Department of the Army
Washington, D.C. 20314

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COVER: The islanders' world may be slowly changing, but the boys of Tangier still spend most of their free time on the water. See page 13.

Water Resources Council In Review

For the 3-year period ending in late 1976, Warren Fairchild served as Director of the Water Resources Council, a Federal agency responsible for forming the Nation's policies toward proper management of its water resources. In the following interview, Mr. Fairchild, now a project manager with the World Bank, offers his reflections and opinions on the past and future role of his former agency.

Mr. Fairchild, how did the concept of the Water Resources Council (WRC) come about?

The concept evolved from a need to better define national water policy and to determine and coordinate programs to implement such a policy. In the United States, water has always been looked upon as a public resource essential to the general welfare of our citizens. The Federal Government sponsorship of water programs, begun in the early 1800's, was limited at that time to defense and commerce. Federal involvement has increased until today it is a $10 billion annual program that encompasses an extremely wide range of activities in seven Departments and 25 major agencies. At the same time, water programs of local and State governments and the private sector have increased in significance. Understandably, there has been a growing awareness that these myriad water programs should focus on achieving national objectives and goals. It was this awareness and need that resulted in the enactment of the 1965 Water Resources Planning Act by the U.S. Congress. Title I of this Act established the U.S. Water Resources Council as an independent Federal agency; Title II provided for the organization of the State/Federal River Basin Commission; and Title III authorized a State water planning grant program. The Interstate Conference on Water Problems strongly supported enactment of this legislation.

What is the current membership of the Council?

Currently, the Federal voting membership of the Council includes eight members -- the Federal Power Commission, the Environmental Protection Agency, and the Departments of Interior, Army, Transportation, Agriculture, Commerce, and Housing and Urban Development.

Didn't Congress make some changes in the membership during your tenure?

Yes, in 1975 the Department of Housing and Urban Development, the Department of Commerce, and the Environmental Protection Agency were added as members; and the Department of Health, Education and Welfare was dropped. This action reflected the changing assignment of water programs in these agencies.

What do you consider to be the most significant change in the operation of the Council during the period you served as Director?

The most significant change was a policy decision by the Secretaries at the Cabinet level to delegate many of their authorities and responsibilities within the Council to sub-Cabinet officials. This delegation, generally to individuals at the assistant secretarial level, resulted in an active Council characterized by frequent and lively meetings.

What would you say this more active Council has achieved in the way of establishing a national water policy?

It achieved the beginning of a true Council mechanism, whereby members share the decision-making responsibilities

of evolving an overall water policy for the Nation. Prior to this, there was a period when the Council was relatively inactive at the members' level, as evidenced by the fact that at one time it did not meet for a period of 15 to 20 months. Because of the infrequency of Council meetings, policy guidance from the members was not forthcoming.

Switching to the future, Senator Church of Idaho has reintroduced as S. 186 in the 95th Congress a bill which would revise the Water Resources Planning Act. If this bill becomes law, how would you appraise the changes that would take place?

They'd be positive. One of the major provisions is that the bill envisions an independent full-time chairman. This would overcome the image that the Water Resources Council is an appendage of, or closely tied to, one of the member Departments, because the Chairman has always been the Secretary of the Department of the Interior. It is my opinion that this change to an independent chairman would make it possible for the other seven members of the Water Resources Council to feel that they were truly equal in the sharing of responsibilities of the Council. The only difficulty I have with the Church bill is the provision that would place the Council within the Executive Office of the White House. I would prefer that the Water Resources Council remain an independent agency. It is my observation that those agencies within the Executive Office of the White House have their ups and downs like a roller coaster. Sometimes they are "on the in," and soon thereafter they may lose favor. Both extremes are reflected in their appropriations and stature. This is not the proper climate for the development of a substantial and continuing national water policy program.

"I would prefer that the Water Resources Council remain an independent agency."

Would you say that the type of legislation envisioned in the Church bill would be compatible with the new administration's plan to reorganize the Federal Government?

Obviously, I am not in a position to speak for the Carter administration. However, on the subject of reorganization of Federal water programs, I would prefer the establishment of a Department of Natural Resources or a Department of Environment and Natural Resources. Past initiatives to establish such a Department have been unsuccessful, but I would hope the present administration would include such a Department in its reorganization of the Executive Branch.

In the absence of such a reorganized Department, I see the Water Resources Council as being a logical and viable alternative to coordinate Federal water programs to meet national water policy objectives. However, it must be recognized that there is an inherent weakness in the Council organization. This weakness, which some people call a strength, is that the Council can be only as effective as its members determine appropriate. The programs of the Council are significant and need to be strengthened, whether it is through a reorganized Council or as part of a Department of Natural Resources.

Would you say that up to this point the Council's agency representation has been fairly even?

I would observe that in recent months agencies have indicated a general feeling of fair representation. This is to the credit of the personalities which were involved as members of the Water Resources Council during the Ford administration. There was a sharing of responsibilities. However, one thing that could be accomplished under the present legislation which would achieve greater equality of representation would be the rotation of the Water Resources Council chairmanship.

Historically, the Chairman of the Water Resources Council has been the Secretary of the Interior, appointed by the President. Legislation does not require this. I am of the opinion that it would be better to rotate the chairmanship among the eight Council members. This would achieve the image of greater equality of representation.

How did this tradition begin?

The tradition started with implementation of the Water Resources Planning Act in 1965 in the Johnson administration. At that time, the Secretary of the Department of Interior was Stewart L. Udall, a strong, early backer of the Water Resources Council. It was only natural that President Johnson appoint him to be Chairman of the Council. Since that time, every President has appointed the Secretary of Interior as Chairman of the Council.

"...the Council can be only as effective as the members determine appropriate."

As far as the members are concerned, were they all equally active in the Council during the period you were Director?

No, they weren't. I think that, traditionally, the active members in the Water Resources Council have been the Federal Power Commission and the Departments of Agriculture, Interior and Army. In recent months, the Departments of Transportation and Commerce have indicated a great deal of interest in the Council's program. I would have to say that I was somewhat disappointed in the level of participation of the Environmental Protection Agency. Obviously, it has major assignments in the water quality area; and, for reasons of its own, apparently it was unable to give priority to Council activities that I personally thought the Council deserved. The Department of Housing and Urban Development was reluctant for various reasons to have certain of its water programs considered during deliberations of the Council.

"...the active members in the...Council have been the Federal Power Commission and the Departments of Agriculture, Interior and Army."

Water programs have been characterized by considerable conflict and controversy in recent years. In your opinion, what single issue has caused the most controversy?

In my opinion, the single issue that has continued to spark many of the controversies surrounding water programs is the Federal role. It is also my opinion that the U.S. Congress is the ultimate authority in national water policy matters, and it is the only body that can determine the level of the Federal role. In the absence of positive congressional direction, other organizations, either by necessity or eagerness, are willing to state and attempt to determine what the Federal role should be. Congress has attempted in various pieces of legislation to lay out the Federal policy for individual water programs, but it has never developed an overall coordinated water policy for all Federal water programs. I would assume that it was because of this situation that the U.S. Congress in section 80(c) of the 1974 Water Resources Development Act requested the President to undertake a water policy study and make recommendations to Congress on planning procedures, discount rate and cost-sharing.

President Ford assigned this study to the U.S. Water Resources Council; but, unfortunately, because of a conflict between the members of the Council and officials of the Office of Management and Budget (OMB), these Presidential recommendations were never submitted to Congress. Basically, the members of the Council saw a significant Federal role in a partnership arrangement with State, local and private water interests; whereas OMB envisioned a much reduced Federal role. I would believe that this conflict in the dying days of the last administration was a major factor in OMB's "zeroing" of the Council's budget request for fiscal year 1978. Commendably, the Carter administration in the first few days of its operation reinstated the funds as requested by the Council.

"Any decision by the Federal Government to. . .stop a project should be made in concurrence with the major parties involved."

It is my observation that it is this same viewpoint of a severely reduced Federal water program, shared by OMB and preservation groups, that has sparked the controversy in the present administration's "hit list" of water projects. The extreme viewpoints on this issue of the Federal role, as reflected by the budget constraints of OMB, preservation goals of conservation groups, and the development aspirations of users' associations, will continue to create controversy on any and all water programs until congressional policy is laid down. Debate on water programs is desirable; however, when it reaches the stage it now has, debate becomes extremely wasteful of natural, financial and human resources.

The U.S. Water Resources Council, or any organization that may succeed it, can be extremely helpful to the President and the U.S. Congress by making professional and rational recommendations on the issue of the Federal role and other major water policy issues. It is my opinion that the moderate position taken by the members of the Council in the section 80(c) study would have been a positive step toward resolving some of these conflicts.

". . .RBC programs should be limited to interstate planning, coordination, policy, and priority setting."

You mentioned the "hit list" of water projects. Do you have any comment on reevaluation of Federal water projects?

It is prudent that all programs and projects be reevaluated. However, there are certain factors that should be kept in mind during any reevaluation. These factors include: stage of development, non-Federal commitment to the project, non-Federal support, and the objectives for which the program or project had been formulated.

Obviously, it is easier to reevaluate and reformulate a project being planned than one being constructed. Decisions on program objectives, financial arrangements, and so forth should be decided upon prior to congressional authorization. Major reformulation and/or stopping of a project once it is authorized and under construction results in dire consequences. Flexibility for change becomes more difficult and limited as a project progresses.

Any decision by the Federal Government to make a major revision or stop a project should be made in concurrence with the major parties involved. In most cases these parties would be State and local government entities. It should be remembered that in most projects there is a non-Federal financial commitment. One party to such an arrangement should not unilaterally revoke an arrangement or understanding.

The best and only true gauges of local and State support for programs and projects are the positions taken by the elected officials. It has always been Federal policy to fully consider local and particularly State positions in the authorization of programs and projects. The same should be true of de-authorization. Congressmen and Senators from these areas also reflect the feelings of their constituents. If not, they will probably have a short tenure in office.

However, a major factor in any reevaluation is an understanding of the planning process. Projects and programs are formulated to a given set of objectives. As an example, most water projects authorized to date have been formulated with an objective of securing long-term benefits. This has been accomplished by employment of a lower discount rate resulting in somewhat larger and more capital-intensive projects. Hence, the last incremental, justifiable unit was normally added to the project, which resulted in a project economically feasible at such a discount rate but with a low benefit/cost ratio. If you raise the discount rate, it should not come as a surprise to anyone that many of these projects in such an evaluation are not economically feasible. What you have done is to change a major planning objective where now you emphasize near-term benefits with a willingness to forego longer term benefits. Such a change may not be traumatic for projects and programs with a short period of time between conceptualization and fruition -- but it can wreak havoc with water programs where such a period of time may be 20 to 25 years. It is my opinion that it is totally inappropriate for economic purists or preservationists to insist that such a reevaluation test be

"The ultimate decision maker is the elected official. . ."

made on projects with major construction underway for the purpose of determining if they should be "scuttled." This reminds me of the dealer in the poker game who stated, "Oh, by the way, deuces are wild and I just won the pot."

What should be the future role of the States in water resource planning and project development?

That is a long-standing question and there is a lot of conflict about it. In general, I would say that the role of the States should be increased. It should be increased for program responsibilities; inherent in this are related financial responsibilities. In my estimation, the thing we should be working toward in the water program is the appropriate partnership role between the Federal, State and local units of government in cooperation with private interests.

"I was. . .disappointed in the level of participation of the Environmental Protection Agency."

How do you see the role of the Title II River Basin Commissions?

I support the programs of River Basin Commissions (RBCs) as evidenced by my personal backing of substantial increases in Federal appropriations for the RBCs in the last several years. We need to recognize that there are certain basic limitations as to how far a river basin commission program should develop. In our Federal system of government, there are three strong levels of government for carrying out programs and projects -- Federal, State and local. A regional institution such as the River Basin Commission is an organization between the Federal and State units of government. It is my opinion that the RBC programs should be limited to interstate planning, coordination, policy, and priority setting. They can be extremely effective in these areas. However, RBCs should never be looked upon as action organizations.

". . .the role of the States should be increased."

How effective are the State/Federal Interagency Committees? Would you explain that and compare them with the River Basin Commissions for effectiveness?

The Interagency Committees are an alternative to River Basin Commissions. In my estimation, they are not as desirable because in the RBC you have a commitment on the part of Federal and State Governments for joint membership, responsibility and funding of Commission programs. You also have the continuity of a chairman and a staff to carry out the policies and programs of the Commission. An Interagency Committee is a more informal organization of Federal and State agencies. This lack of formal arrangement prevents it from being a party to major agreements or contracts, which is a very limiting deficiency. The Committees can carry out a limited program of coordination and planning; and, based upon the willingness and support of the members, they can carry out about the same program as the River Basin Commissions. But, from a practical standpoint, it would be almost impossible to expect an Interagency Committee to do so because of its lack of legislative forum and current inadequate funding.

In some areas the Interagency Committee is the logical alternative to the RBC because many States, and sometimes Federal agencies, feel quite strongly that most programs of planning and coordination should be carried out by the State and/or Federal agencies. In such cases, an informal organization like the Interagency Committee can play a planning and coordination role when and where deemed appropriate.

Which program initiative do you consider to be the most significant during your Directorship?

This would have to be the development of the Water Assessment and Appraisal Program as envisioned and authorized in section 102 of the act. This program was initially funded in fiscal year 1976. When operational, this program will make information available to the Council of Members, which should be of value to them in making recommendations to the President and the U.S. Congress. These recommendations would serve as a guide in allocating scarce resources to meet the critical water requirements of the Nation. Inputs to this program will be State and regional plans, priorities flowing out of these plans as determined by the responsible State and regional entities, and the national water assessment as prepared by the Council. The data base for this system is to be built upon professional inputs of natural resources specialists from all levels. Properly implemented, this program will enable such input to be fully considered in the decision-making process. It is this program that can make effective the various provisions of the 1965 Water Resources Planning Act as envisioned by the U.S. Congress.

"The present Principles and Standards need to be rewritten."

In retrospect, what would you now do differently over the 3 years you were Director of the Council?

I am not certain I would do anything differently; however, there are certain activities I would now want to give greater emphasis and personal attention. These activities include increased coordination and communication with States, additional attention to the National Assessment Program, and revisions in the WRC Principles and Standards for the formulation and evaluation of Federal water programs.

The Council has always enjoyed a good relationship with the Interstate Conference on Water Problems. The Council has established a Standing State Advisory Committee. Even though the significant water role of State governments was recognized, additional attention should have been given to the concerns and interests of State officials.

The National Water Assessment Program is a major Council responsibility. I did not allocate enough of my time to this important program. The major objective of the National Assessment Program is the identification of the critical water requirements of the Nation. Obviously, this activity, if properly carried out, is a key input to the national decision-making process on water programs.

The current P&S needs to be rewritten to broaden the scope of Federal program coverage and to make the programs easier to apply and understand. The Council of Members initiated this rewrite last year and it needs to be completed. The present P&S is unnecessarily complex and difficult to apply. Many of the

details should be deleted and inserted in the planning procedures of the Federal agencies. The basic concept of preparing alternative plans to emphasize the two co-equal national objectives of economic development and environmental quality should be retained. However, the process needs to relate man as part of the environment, which the P&S does not now do.

How do you see the trade-offs between these two national water planning objectives of economic development and environmental quality?

There are instances when these two objectives are in conflict with each other and there are instances when they are complementary. Some of the perceived conflict is between the extreme views of the preservation groups on environmental quality and the traditional water user groups' views on economic development. The concept of the WRC Principles and Standards is to array the effects of alternative plans emphasizing both of these objectives so the decision maker can determine the economic or environmental trade-offs related to his decision. Many times the accepted plan will be an alternative that attempts to balance the trade-offs involved. An important consideration in this process is that the water planner is not the decision maker. The ultimate decision maker is the elected official who is held accountable for his decisions in the polling booth.

Do you believe the Council can be the one Federal body that can generate a true national policy in water resources for consideration of the U.S. Congress?

My answer is yes. Certainly the recent activities of the Water Resources Council under the direction of the alternates appointed by the members have indicated to me that the Council can give leadership in this area. But such a program is fraught with all types of problems. In such a program, the Council touches upon some extremely sensitive areas. Consequently, policy or recommendations made by the Council must be founded on a high degree of professionalism and based upon inputs from the States and regional areas of jurisdiction with opportunity for review and comment by public and private interests and organizations. There are inherent conflicts between the Council with its operation in this particular program area and the Office of Management and Budget with its management responsibilities. I support the need for a strong body, such as OMB, that is able to work with the President in the allocation of the Nation's limited financial resources to meet priority concerns. But I feel strongly that the policy and management for programs should be handled by the appropriate Departments, where the professional and specialized expertise is available as backup for decisions, which in my opinion are then likely to be in the national interest. While I support an even stronger role for the Office of Management and Budget in the budgeting area, it is my opinion that it is totally ill-equipped to consider water policy matters which should be within the purview of the Water Resources Council and its member Departments. This is my understanding of the Carter administration position of delegating greater responsibility and authority to the Cabinet Secretaries in running the programs of their Departments.

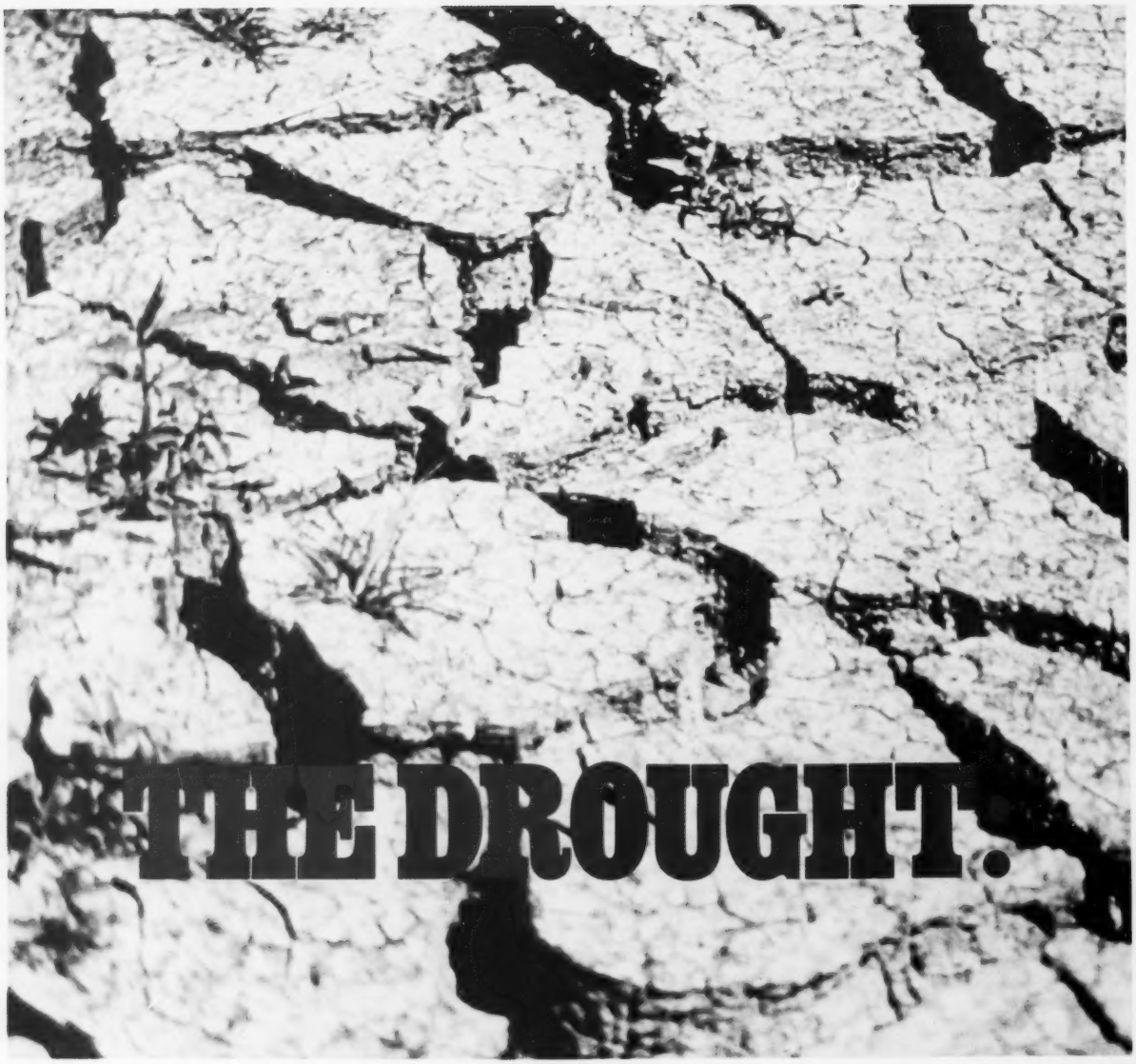
". . .the single issue that has continued to spark. . . controversies. . .is the Federal role. . ."

". . .the U.S. Congress is the ultimate authority in national water policy matters, and it is the only body that can determine the level of the Federal role."

". . .the Office of Management and Budget. . .is totally ill-equipped to consider water policy matters. . ."

What do you see as near-term future trends for national water programs?

The present priority emphasis on water quality programs will continue. Greater emphasis will be placed on water management in an effort to make better use of existing supplies. There will continue to be an effort to achieve a balance between economic and environmental objectives, which is easier said than done. However, with the continuing economic and social problems of this Nation, I believe the social well-being of man will receive greater attention and this should be the bottom line in any program ledger sheet. I do have grave concerns about the current downgrading of technology and capital improvements, which, if continued, will, in my opinion, have a deleterious impact not only on water programs but on the well-being of the Nation. ■



by
Thomas J. Buchanan
and
Bruce K. Gilbert
Hydrologists
U.S. Geological Survey
Reston, Virginia

"Drought" means different things to different people. Even scientists and water managers are not always in agreement as to just what constitutes drought conditions. A good general definition is that a drought exists when there is insufficient water to meet established human needs. When required to cut back on the use of water because of a shortage, many people feel a level of concern similar to that which was evident not so many months ago among motorists waiting in line for gasoline at filling stations. Doing with less, and certainly doing without, often produces anxiety.

Today, millions of Americans have no problem relating to a common plight; many parts of our Far West and Great Plains are in the midst of a serious water shortage. And the situation in some places is expected to get worse before it gets better. All of us will feel the resulting effects either directly as a decrease in water or because of increased costs -- particularly for energy and agricultural goods.

Hydrologists can pragmatically report on recorded data which show that almost every year, some area of our country experiences the conditions that constitute a drought. Now, however, many parts of the United States have had greatly deficient precipitation during the past 15 months and, thus, are coming together in facing an unusually widespread problem. A traveler arriving at

San Francisco Airport is apt to be greeted by a guard checking baggage stubs with the admonition that if the visitor didn't arrange to carry along some rain with him, he should please use California wine in place of water whenever possible.

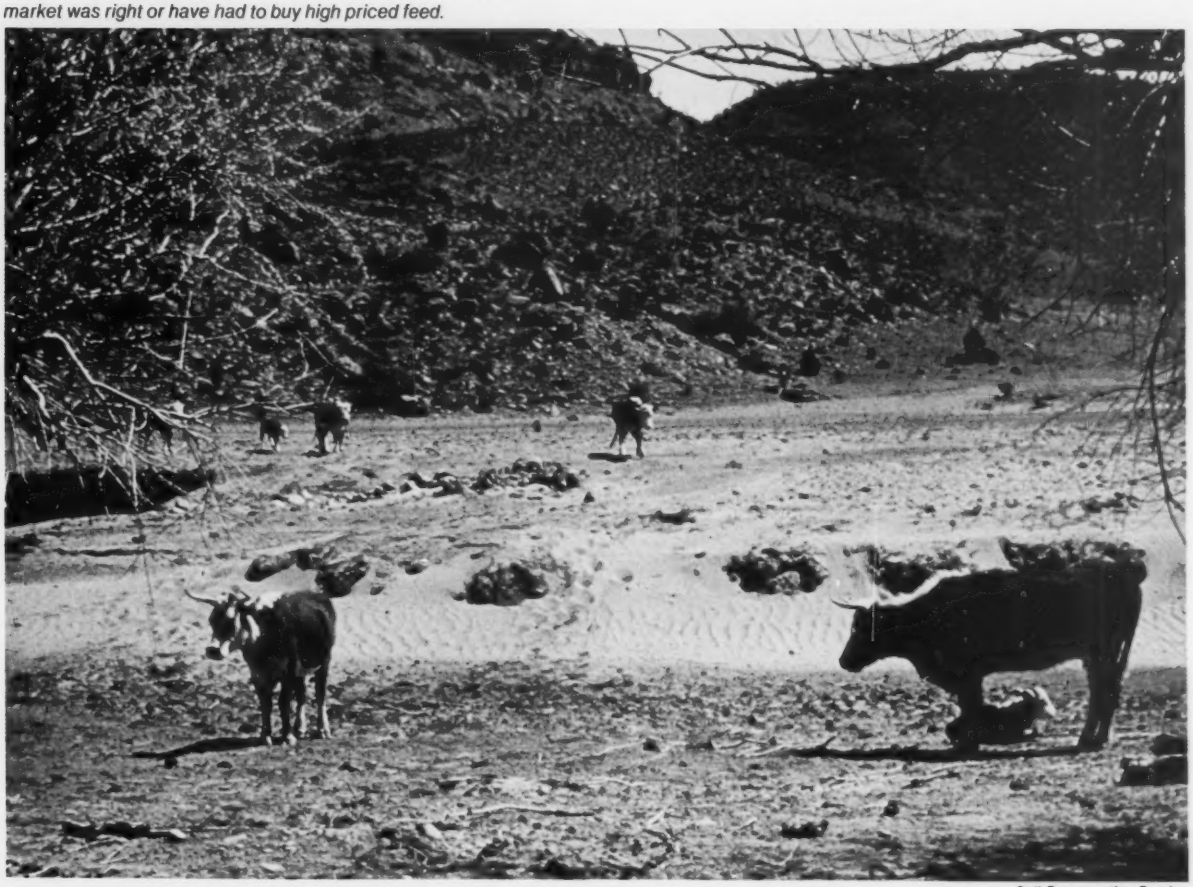
In addition to dealing with shortages of water supplies for domestic, municipal, industrial, and agricultural uses, down the line a number of undesirable environmental effects are already evident or in prospect. For example, fish and wildlife habitats will become increasingly scarce, the potential for brush and forest fires is increasing, and wind-erosion of rich topsoil is underway. Our legislators, managers and planners, consequently, have a real job cut out for them in trying to find ways to tide us through.

Streamflow and Ground Water

When a drought occurs, the effect on the Nation's water resources continually grows more noticeable. Streamflow decreases, groundwater levels drop, reservoir storage is depleted, and water quality is degraded. One simplistic, but direct and quantitative means of determining the seriousness of the situation, is comparing current streamflow with the historical record. Although the areas most severely affected thus far have been the Far West and the Upper Midwest, drought conditions were most widespread at the end of February 1977 when streamflows in all or parts of every State except Florida and Louisiana were generally much below normal. It should be emphasized that the Northeast experienced the most severe winter of record in which exceedingly heavy snowfalls took place in some parts of the area. The below normal streamflow there was a result of water being locked in place as ice and snow and was not indicative of the drought severity.

During March and early April 1977, streamflow conditions improved somewhat in the eastern half of the United States as the result of rainfall and snowmelt from the unusually high snow pack in parts of the Northeast. In fact, some parts of Virginia, West Virginia, Kentucky and Tennessee were reporting high runoff conditions and even disastrous flooding in parts of Appalachia. In early April in the Upper Midwest, flows in some streams were approaching normal, and groundwater levels were beginning to recover. Paradoxically, however, floods are not always the universal antidote to droughts. Often during exceedingly rapid runoff, the normally slow process of recharge to groundwater reservoirs cannot take place. Flood waters may come and go

Many ranchers have been forced to sell their stock before the market was right or have had to buy high priced feed.



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leaving the aquifers (underground water-bearing formations) only slightly better off than before.

Groundwater levels can be another indicator of drought. In large areas of the United States, these levels have been declining as the result of a lack of recharge and because of increased pumpage. In the northern parts of Wisconsin and Minnesota, and in the western part of Michigan's Upper Peninsula, the decline of the water table to record or near-record lows has caused many shallow wells to go dry. The number of dry wells in March is conservatively estimated to have been about 1,900 in Minnesota, 500 in Wisconsin, and 1,400 in the Upper Peninsula of Michigan. Although most of these wells are less than 25 feet deep, they provide adequate water supplies for domestic use in normal years. With water table levels in mid-March in western Minnesota, for example, at record low levels (2 to 13 feet below average), many of these shallow wells either went dry or the yields were no longer adequate even for a home supply. The water table did not actually drop below the bottom of many of the wells, but there was a dewatering of the zones which supply most of the water to a well.

In parts of California, Nevada, Oregon, and Washington, well drilling and groundwater pumpage have increased significantly in an effort to supplement deficient surface-water supplies. For example, the severe drought in northern California and adjacent Nevada has resulted in extremely low streamflow and thus, obviously, a corresponding reduction in available surface-water supplies. Pumping of ground water to supplement the normal surface supplies is planned for four basins in northern Nevada and pumpage for the cities of Reno and Sparks is expected to increase threefold. To compensate for the scarcity of the normal surface-water supplies in the agriculturally rich San Joaquin Valley of California, development of groundwater sources is on the rise. For example, there is a trend toward reactivating thousands of unused or abandoned irrigation wells in the valley.

As a result of the drought, storage in many major water supply and hydropower reservoirs is far below normal, especially in parts of California, Oregon and Washington. The Bureau of Reclamation reported that they have been able to collect all the runoff generated in Washington's Yakima River basin reservoir system. During the last 6 months, however, they have accumulated only about 295,000 acre-feet (96 billion gallons), which is about the same amount collected in just 3 days during a flood in December 1975. Furthermore, because the small water content of the existing snowpack will produce scant additional runoff, it is estimated that less than half the normal supply of irrigation water will be available this summer from the Yakima River reservoirs.

Quality of Water

During a drought, the first concern is with the diminishing quantities of water, but water quality problems can be expected to follow close behind. Already there has been degradation of stream quality in areas of the West and Midwest, and continued low flows will create further and more pervasive deterioration. One of the most critical problems likely to affect water quality as a result of a prolonged drought is simply a lack of sufficient water to flush and dilute contaminants in the stream channel. Wastes from upstream discharges can conceivably build

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Many farmers who depend on irrigation are short of water this year.

The low moisture soil conditions existing throughout the 17 western States are exposing large areas to wind erosion.

Soil Conservation Servic

to the extent that the reduced flows available downstream will become unusable.

Dissolved-solids concentrations are used to indicate the quality of water resources. The concentration of dissolved solids in some streams in parts of Ohio, North Dakota, South Dakota and western Colorado has reached near record highs. If streamflows continue to decline, these concentrations will increase. This can cause the affected water to have an unpleasant taste and may interfere with sensitive industrial processes.

The combination of drought and severe winter conditions has had an extraordinary effect on increasing the concentration of dissolved solids in streams. In normal winters there is an increase in the dissolved-solids concentration in streams because the groundwater outflow to the stream is diluted less by surface-water runoff. As a result of the February cold snap in Ohio, for instance, record high dissolved-solids concentrations were measured at several monitoring sites. Concentrations in the Cuyahoga River at Independence reached almost 2,000 milligrams per liter -- 50 percent greater than ever measured before.

Oxygen deficiency is also a characteristic of prolonged low flows. Less flow means less water to assimilate oxygen-demanding wastes. In Minnesota, for example, dissolved-oxygen concentrations were nearing zero in some reaches of the Mississippi and Minnesota Rivers until late March and early April when rains more than tripled flows. Such "sags" in oxygen concentrations can be lethal to fish and other aquatic life, cause odor problems, and decrease a stream's natural ability to purify itself. In California, the flow of the Russian River has declined to the extent that sewage discharges from oxidation ponds account for 40 to 50 percent of the total flow -- normally at this time of the year, sewage discharges account for less than 10 percent. Undesirable odors and heavy growths of algae have already occurred, and even lower dissolved-oxygen concentrations may result as water temperatures increase during summer.

In general, the shallow water created by low streamflow causes warmer water than usual. Also, stream temperatures downstream from depleted reservoirs are expected to be higher in time of drought because of the lack of release of deep, cool water from storage. This is particularly noticeable when snowmelt runoff is deficient. Increased water temperatures can seriously impact aquatic life; trout, in particular, cling to life tenuously as streams grow warmer. Obviously, those using streams as sources of cooling water face problems. And the rate of evaporation is increased which further decreases this limited supply of surface water.

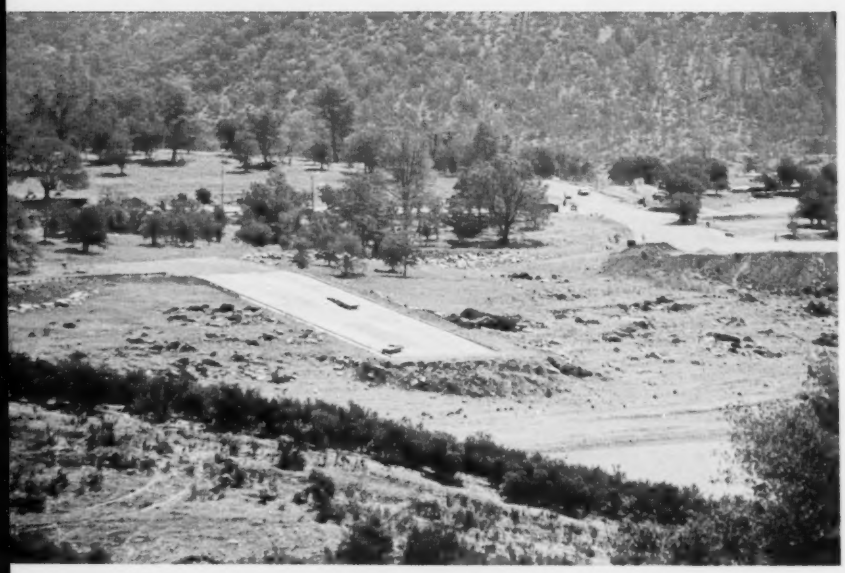
In coastal zones, fresh water in streams and aquifers is always in contact with seawater. Decreased streamflow and additional withdrawals of groundwater in these areas increases the inland movement of salt water, further threatening existing sources of supply.

Water Supply

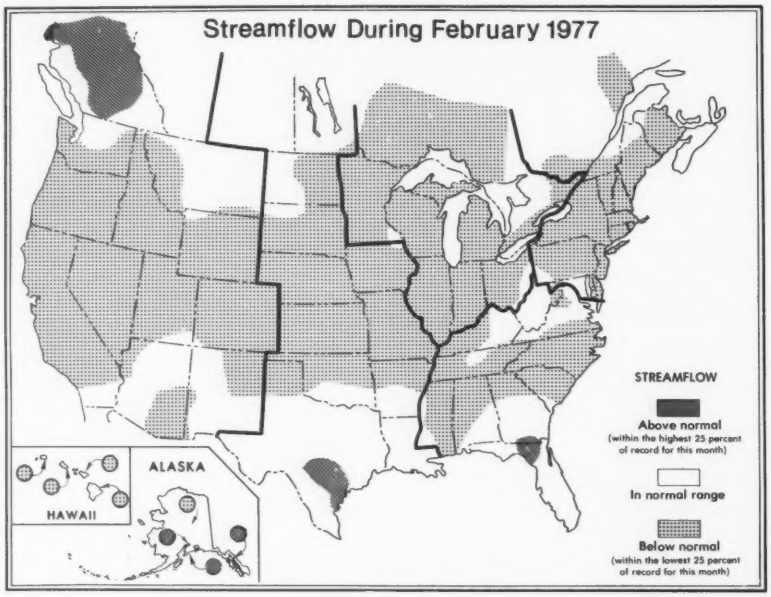
Water supply problems are legion but the most severe so far are in the northern half of California. In that area, water rationing with both mandatory and voluntary restrictions is being implemented in many communities. The most significant rationing plan is the one implemented on April 1 by San Francisco which hopes to reduce water use by 25 percent. Home owners and industry both must reduce their water consumption; and, if the reductions are not met, plans are to place restricters in the water lines of individual users. These devices will cut the flow of water to affected lines to a trickle. In addition, the user will be charged for the cost of the installation and eventual removal of the restricter.

In some areas of Oregon, there have been industrial layoffs because of water cutbacks, and similar circumstances are anticipated in other stricken areas. Further unemployment can be anticipated if power production in the Northwest is as low as is forecast for late summer.

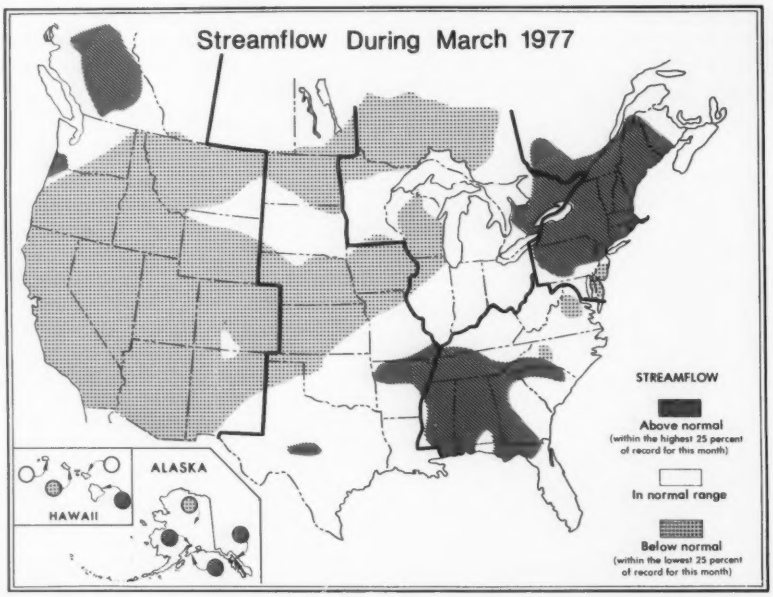
Agriculture has been seriously affected throughout the period of the current drought. Even in 1975, areas in



This dead-end road is actually a boat launching ramp that is usually covered by the waters of New Hogan Lake, Calif.



Streamflow was below normal throughout most of the Nation during February 1977.

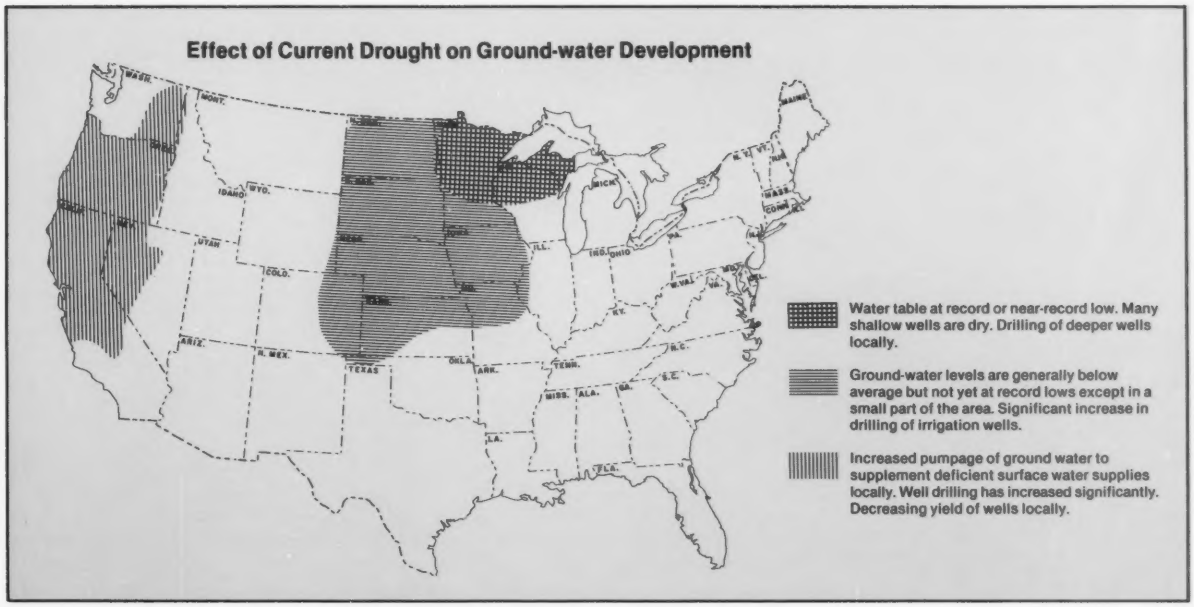


During March, the western United States was still experiencing below normal streamflow. East of the Mississippi River, streamflow was normal or higher.

the Upper Midwest produced poor quality crops and a reduced yield because of lack of precipitation. This effect of drought spread throughout much of the western United States in 1976 and early 1977. Many farmers have been forced to delay plowing and seeding because of dry conditions, and in other areas seed and seedlings have been damaged because of the lack of moisture. Range lands have also been affected, and many ranchers have been forced to sell their stock before the market was right or have had to buy high-priced feed to maintain their stock. Many farmers were forced to haul water to accommodate their most urgent needs.

Another serious effect on agriculture is the loss of rich soil to the combined forces of wind and drought. The dust bowl conditions in the Midwest in the mid-1930s created disastrous problems in Colorado, Kansas, Nebraska, Oklahoma and the panhandle of Texas. The current drought already has revived these old memories.

The drought has had, and will continue to have, serious effects on power production in the United States. In the Northwest, which relies on hydropower for 80 percent of its electricity, reservoir content is well below normal; the snow pack is extremely deficient; and, consequently, the outlook for power production this summer is very bleak. Many agencies are currently trying to develop contingency plans for attempting to satisfy the power


Effect of Current Drought on Ground-water Development
Water table at record or near-record low. Many shallow wells are dry. Drilling of deeper wells locally.
Ground-water levels are generally below average but not yet at record lows except in a small part of the area. Significant increase in drilling of irrigation wells.
Increased pumpage of ground water to supplement deficient surface water supplies locally. Well drilling has increased significantly. Decreasing yield of wells locally.

Contents of Selected Reservoirs Near End of March 1977
EXPLANATION
•74 (percent of average for near end of March)
39 (contents for near end of March 1977 expressed as percent of normal maximum)
Italics indicate below average contents

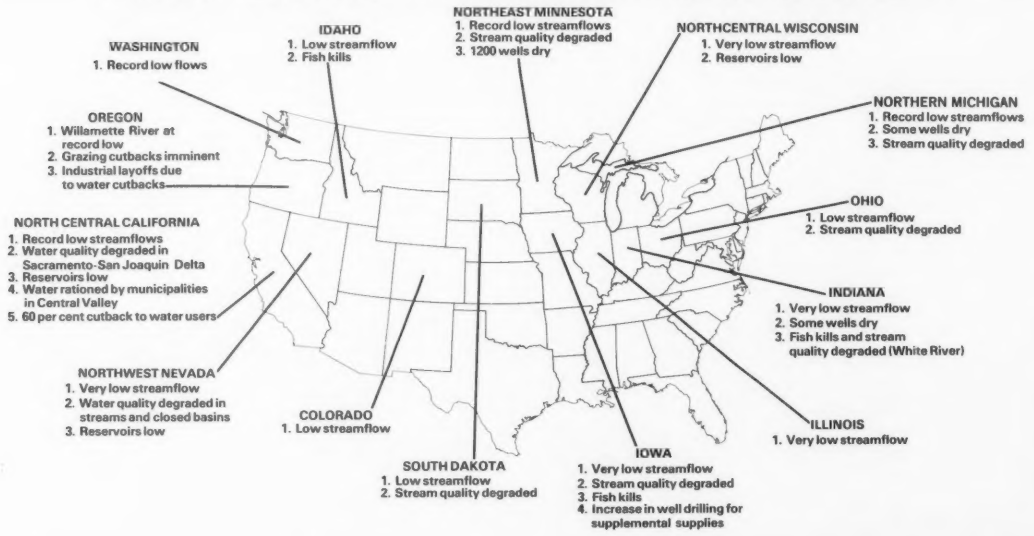
needs of the Pacific Northwest as the drought continues.

Fish and wildlife resources have also been severely affected by the current drought. In many places, there has been insufficient water in the streams for spawning by various species of fish; in other areas streams have dried up, killing the entire fish population. In many of the wetland areas in the West, the normal forage areas are not capable of maintaining the wildlife and migrating waterfowl as in normal years.

Recreational opportunities have also been curtailed. Western ski resorts by and large have reported a most depressing season. Millions of dollars in income have been lost as the result of the lack of snow. In addition, many park areas have been closed, and many others are on alert because of the threat of fires due to the extremely dry conditions. Economic conditions in these resort areas are likely to be impacted severely.

Another problem is the potential threat of land subsidence in northern California. Aquifer withdrawals have been reduced in recent years in the San Joaquin Valley and, thus, groundwater levels have risen. Now, because of the serious drought, abandoned wells are being put

CURRENT WATER PROBLEMS RESULTING FROM DRY CONDITIONS



back into production and pumpage is increasing. If large-scale pumping is resumed, however, groundwater levels will fall again; and land subsidence may reoccur.

In addition to voluntary conservation measures and rationing, efforts are underway in many areas to tap new supplies and redevelop old ones. Thousands of wells have been drilled and a multitude of existing wells are being deepened in an attempt to provide relief to domestic, municipal, industrial and agricultural users. Some of the power companies in the State of Washington are seeding clouds in an effort to produce rain to replenish reservoir storage. However, there has at times been serious difficulty in finding suitable clouds to seed, and the effectiveness of seeding operations is hard to evaluate.

To assist the affected areas, President Carter has proposed a comprehensive drought-assistance package that asks for $594 million in loans and $250 million in grant monies. Special features of the program include $300 million for community water supply loans and another $150 million for grants by the Economic Development Administration. Also included is $100 million in grants for soil conservation practices under the program of the Agricultural Stabilization and Conservation Service, and an increase of $50 million in loan authorizations for small businesses.

Some States have voted emergency funds to assist with drought problems. For example, in Washington, Governor Dixie Lee Ray signed a bill providing $33 million for domestic drinking water projects and for aid to irrigation developments in the eastern part of the State.

The Outlook

Despite efforts to conserve and more efficiently manage water supplies and legislated financial aid, the prospects for the coming months are bleak. The sole panacea to the drought is prolonged and copious amounts of precipitation.

For some water users, a drought can be considered broken with the first major rainfall that prov des some relief to the native vegetation. For others, particularly water managers concerned with reservoir storage or well-field operations, the effects of the drought may linger for a year or longer after a period of normal precipitation begins. Even though a few areas of the United States have had some relief from the drought, other regions continue to be severely affected. Most citizens will feel the sting of the drought this summer as they watch food prices climb.

The full effects of the extremely deficient snowpack in the West are yet to be felt. Runoff from this usually dependable source is expected to be well below normal this summer. Thus, the timing of the additional precipitation needed is also a critical factor. Rain must come in quantity before the onset of next winter; even if greater than average amounts of snow fall, streamflow may not be replenished until a year from now. By then the situation with respect to both the quantity and quality of our water resources could be at a desperate level.

Based on the historical record, we can expect more droughts. To minimize the effects of future drought we need to develop a better understanding of our existing water supply, our anticipated water needs, and our current water use. And we must make more efficient use of the existing water resources.

Using this background, decisions on agricultural, industrial and municipal developments may be made with a fuller awareness of the potential effects of droughts on our society and its economy. A bold group of skillful and persuasive planners will be called on to evaluate trade-offs among competitive users. Unlike energy, we're not using up our water overall, but learning to adjust to the changes in its quantity, quality and distribution in time and space. This is every bit as crucial to the Nation as developing new fuel sources.

Tangier Island Today

by **Gerald Barnes**

Living on a 3½-mile-long dot of land in the middle of the Chesapeake Bay has long accustomed the people of Tangier to depending on the sea for survival. For nearly 300 years they have shared a quaint yet demanding life-style with the Bay which supports, occasionally entertains, and sometimes even imprisons them.

More than 90 percent of the 250 able-bodied menfolk on the island earn their livelihood from seasonal pursuits of crabbing (the world-famous Chesapeake Bay blue crab and other varieties), oystering and fishing. In the American tradition, each is a persistent and proudly independent businessman.

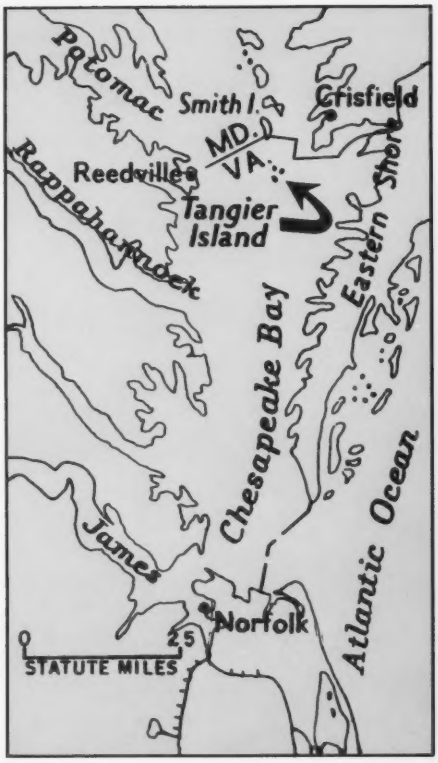
On Tangier, a boy grows up with the sea, while a girl is taught the patience, allegiance and strength of a fisherman's wife. At the age of 4, most boys are amphibious, easily able to wade, dive, swim -- and occasionally even work by searching for crabs and clams in the shallows around the island. By the time he is 16, a boy has gained more than enough experience to be thought of as a seasoned waterman. About half of the youth who grow up on the island leave to pursue a different life, but many of them return.

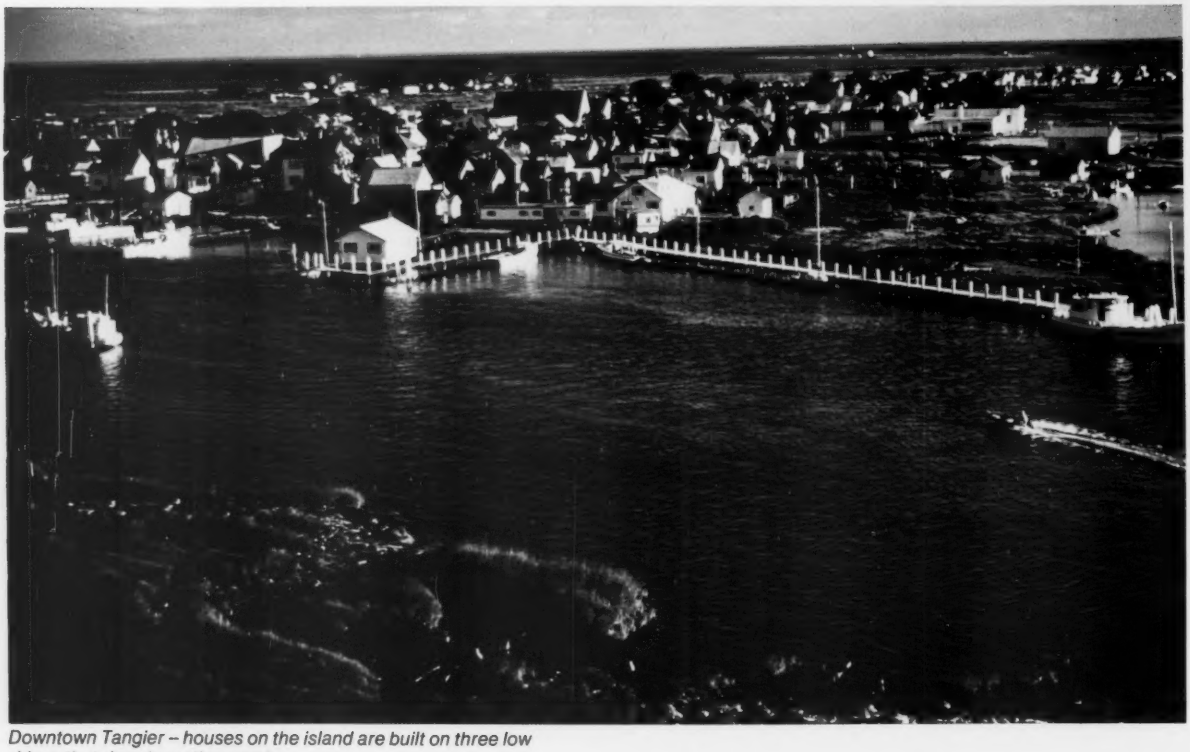
For Tangiermen, boats hold the same place as cars do for the rest of us. Everybody has to have one, two or even three as dollars dictate. There are skiffs for little folks, outboards for youths and, of course, work craft and pleasure boats for breadwinners.

On the island itself, transportation is safe and reliable. People walk. A few folks have bicycles, fewer have motorbikes, and, at last count, only seven persons own automobiles. There are no early morning or late afternoon traffic jams on streets so narrow that one can jump across.

Family lines go back to the 17th century. When Captain Smith discovered the island while on a 1608 expedition

Mr. Barnes is Executive Assistant with the U.S. Army Corps of Engineers in Norfolk, Virginia.





Downtown Tangier -- houses on the island are built on three low ridges that rise above the marsh.

from the English colony of Jamestown, he found no one living there. Apparently, Indians were using the area only for hunting and fishing. In the Captain's diary, Tangier and its nearby neighbor, Smith Island, were termed "uninhabitable isles." Legend has it that no permanent settlement of Tangier occurred until an Englishman named John Crockett, together with his sons and their families, settled there in 1686. Mail boxes on Tangier's narrow streets still reflect the original family names of Crockett, Pruitt, Parks, Dyer, and Dises.

Tangier residents point with pride to their part in the American heritage, highlighted by the 1812 British occupation. The "foreign" army used Tangier as a base of operations to bombard nearby Baltimore and Washington. During an unsuccessful British attack on Baltimore's Fort McHenry, Francis Scott Key penned the words to "The Star-Spangled Banner."

Like their forefathers, Tangiermen love the 7 square miles of marsh and earth each calls his home. By the same account, these proud folks cherish the independence and right of self-government which has seen them safely through nearly three centuries.

Thus, when the Federal Government, principally in the form of the Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers, entered into their independent world in 1976 with their special mandate to protect the island's environmental resources, some resentment flared. Many people felt they did not need outside direction to protect either their island, its wetlands, or the environment that surrounded them.

The islanders have maintained a working relationship with the Corps for nearly 70 years. Since 1919 the Corps has connected Tangier to the mainland with one and later (1964) two navigation channels. Both channels are in constant use.[1] Mail and supply boats make daily runs, and petroleum barges bring the resource which heats most homes and fuels the island's autos, motor bikes and fire engine. Special or emergency trips to the mainland are necessary for medical treatment, shopping or visiting. During good weather, tour boats come and go with loads of inquisitive "mainlanders" eager for a glimpse of the island, its people and their unusual way of life. And, of course, there is the daily movement of the fishing fleet. Life on Tangier exists because of these navigation projects and could not survive long without them.

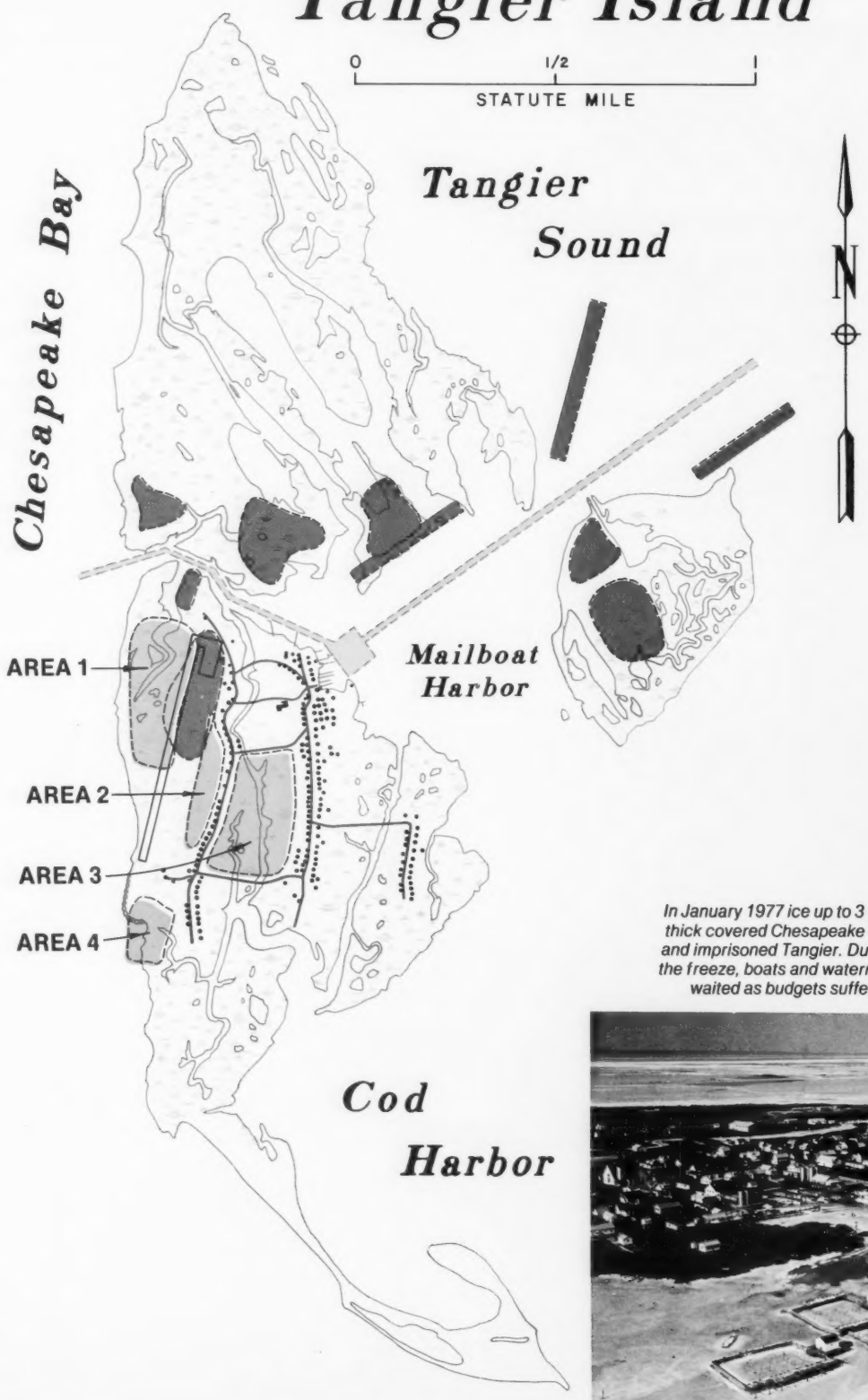
The Chesapeake Bay regularly fills the east and west channels with clean sand and silt, and every 2 or 3 years it is necessary for the Corps to restore the authorized depth by maintenance dredging.

In times past -- before EPA and Corps personnel disembarked on Tangier to protect the valuable wetlands -- the arrival of a dredge was viewed as a unique opportunity. Disposal of material dredged from the channels was never a problem, for the sand and silt were valued as fill -- 80 percent of the island is estimated

1 Although a small airstrip was built on the western shore in 1968, boats still bring in the bulk of supplies and provide most of the transportation to and from the island.

Mail and supply boats make daily runs, bringing essential supplies and even visitors to Tangier.

Tangier Island



In January 1977 ice up to 3 feet thick covered Chesapeake Bay and imprisoned Tangier. During the freeze, boats and watermen waited as budgets suffered.

to be some variety of marsh or wetland. Tangier residents and the Corps had always jointly selected the disposal sites which dot the island. Through the years, these sites have been used as locations for such things as a recreation area, a community center, an airport and some homesites.

Today, dredged material disposal is no longer an easy matter for the islanders to deal with. For them, it has become a difficult and perplexing problem. NEPA and Public Law 92-500[2] appear to mean little to men who have lived "on top of a marsh" for their entire lives. "Why, the whole island is nothing but a marsh," one resident was heard to say. "Don't they understand that we have to live somewhere? We can't protect every bit of this marshland."

To many of the folks on Tangier, the past 2 years have brought a full realization of the strength of our national commitment to environmental protection.

Early in 1976 both channels were beginning to shoal heavily. Funds were appropriated by Congress for the necessary dredging work. The town fathers met in June with representatives from EPA, the U.S. Fish and Wildlife Service, National Marine Fisheries Service, and the Corps to select disposal areas. The residents were asked to designate acceptable sites. They chose a wetland area, No. 1, on the eroding western shore near the tiny airstrip. This site was preferred since they believed the fill would protect the eroding shoreline and provide additional recreation areas and space for a proposed new sewage treatment plant. Environmental agencies rejected this site, stressing its natural value and opposing its use for disposal. The agencies suggested using overboard disposal as a possible alternative. Islanders objected to this "waste" of material and strongly disagreed with the rejection of area No. 1. Sites 2, 3 and 4 were also considered but rejected by the agencies. At the time an impasse prevailed.

Several days later, compromise seemed possible when the agencies reevaluated their objections to areas 2, 3 and 4, then approved sites 2 and 4 and reiterated approval of overboard disposal. The islanders again voiced their opposition to all but area No. 1. In their view, area No. 2 was too close to homes along the heavily settled west ridge, area No. 4 was too small to receive all material to be dredged, and overboard disposal was not acceptable to them because of its potential for damage to valuable shellfish beds. Thus, the stage was set for what then appeared to be a long wait.

Negotations stalled for well over 6 months. The channels were becoming increasingly impassable. In December 1976, an oil barge grounded in the west channel and its owner refused to deliver more fuel to the island until the channel was dredged. The mail and supply boat began experiencing navigating difficulties during lower tide levels. By January, the worst winter in 40 years had set in, the island was down to less than a week's supply of fuel, the school was operating on a shortened schedule to conserve oil, and individual homes were conserving oil wherever they could.

About the same time, the island received word that funds appropriated for the channel navigation projects would have to be transferred to other projects if a disposal site was not soon approved.

On January 17, 1977 the impasse ended when the town council reluctantly voted to accept areas 2 and 4 which had been approved by the environmental agencies.

The problem of disposal has been solved for the time being. It will again return. However, other problems, perhaps more serious than the disposal question, remain. Among these are devastating summer storms, the relentless pursuit of erosive wave action, and bone-chilling winter weather.

Tropical storms have always brought havoc and suffering to Tangier. In August 1933, Chesapeake Bay waters inundated everything on the island but second stories of the neat clapboard homes which stand side-by-side along the streets. Today, occasional summer storms blow up and remind everyone with a "spray"

2 The National Environmental Policy Act of 1969 (NEPA) and the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500) are the basis for the efforts to protect, preserve and enhance the island's wetlands.

An increasing number of people are visiting Tangier. Most of them bring cameras and lots of curiosity and leave a few dollars in the souvenir shop or the Chesapeake House.

Mrs. Crockett, an influential resident who operated the island's only restaurant and lodging house, died in 1975. Her influence and memory linger on Tangier.

from high seas that disastrous floods could come again with little warning.

Perhaps the most far-reaching problem confronting Tangier Island is the one least obvious to the visitor -- erosion. Exactly how much of the island has been lost through the years is not known. However, records and charts dating back to 1850 indicate that the western shoreline is receding about 20 feet a year. The erosion's severity was clearly obvious in 1975 when the airstrip's southern end, along with approach lights and pavement, crumbled into the Bay.[3]

In the winter of 1977, the residents of Tangier Island endured the least predictable and potentially the most serious problem of all -- ice.

Older residents remember well the winter of 1936 when ice as much as 18 inches thick completely isolated the island for almost 2 months. There were no snowmobiles then, and no airstrip. Emergency medical and food supplies were flown over the island by the Army Air Corps and dropped by parachute. Although not as prolonged, the freeze of '77 was more severe as frigid air, high winds and ice up to 3 feet thick again imprisoned the island for several weeks.

Economic impacts on watermen were painful. Budgets suffered as the men were forced to wait for the thaw, while wondering how the freeze would damage their piers, waterfront facilities, boats and oyster beds. Throughout the agony, one statement by an idled waterman typified the resolve of the island's population when he said, "It's bad, but we'll wait and it will soon be over."

Many of the islanders' good times are church-centered. Most people are regular church-goers at one of the island's two "meeting" places. The school is a focal point for leisure activities of the children. A recreation field permits occasional ball games, picnics and similar activities. The well-equipped neighborhood center was recently completed and will be used for numerous town gatherings, both business and social. People also enjoy the normal water sports including boating, skiing, swimming -- even occasional pleasure fishing. For the most part, however, the sea is viewed as a means of livelihood rather than an opportunity for recreational enjoyment.

An economically pleasant situation which islanders are adjusting to is the gradual increase in visitors. In 1976, tourists' visits exceeded 10,000. This year, between 15,000 and 20,000 curious visitors are expected to arrive, take pictures, leave a few dollars in the souvenir shop, and then depart.

Tourists can be assured of a pleasant time when they visit Mrs. Crockett's Chesapeake House, the only restaurant and lodging house on the whole island. Mrs. Crocket died 2 years ago, but her nieces still run it according to her high standards. With family style service, the daily menu consists of crabcakes, clam fritters, Virginia ham, corn pudding, green peas, coleslaw, applesauce, potato salad, hot rolls, ice tea and pound cake.

Tangier Island -- special people and a very special place! ■

Following the January agreement on disposal areas, material from the west channel was placed in area No. 4 in a joint effort by the Federal Aviation Administration, Virginia Airports Authority, Corps of Engineers, County of Accomac, and Town of Tangier. Area No. 4 has been riprapped to protect the southern end of the airstrip from erosion. At the same time, the filled area will provide a much needed 1,000-foot extension to the runway. As of this writing, final plans for dredging the east channel are underway. Dredged material will be placed in area No. 2.

Why were so many Federal, State, and local agencies willing to work in harmony over an extended period of time, reassessing their positions and maintaining a spirit of compromise? Any number of reasons perhaps. Prominent among these was a realization by all that the very lifeblood of this tiny island and its 900 hearty inhabitants depends on the two navigation channels.

3 A State task force with Corps of Engineers participation has been studying the erosion problem on Tangier in order to recommend possible solutions to the Governor.

by **Stewart H. Fonda, Jr.**

The IJC A Neighborly Idea

Power Authority of the State of New York

The IJC monitors projects as complex as the St. Lawrence River's Moses-Saunders power dam and the Long Sault dam, visible in the distance. One of the largest hydroelectric generating stations in the western world, the U.S. half (Moses) is operated by the New York State Power Authority and the Canadian half (Saunders) by Ontario Hydro.

The United States and Canada in 1909 established a unique organization to prevent disputes and resolve differences along their 5,000-mile common border, half of which is streams and lakes. The six members of this permanent commission act not as separate national delegates but as a single nonpartisan body, seeking solutions to the problems that inevitably arise with development and exploitation of common resources, particularly water. More than 100 matters have been referred to the International Joint Commission since it began operating in 1912, but on only three occasions has it divided along national lines.

The idea behind the creation of the Canadian-United States Boundary Waters Treaty of 1909 and the International Joint Commission (IJC) it established was first voiced in 1894 and 1895 at International Irrigation Congresses held in Denver, Colorado and Albuquerque, New Mexico. Resolutions adopted unanimously by the Mexican, Canadian and U.S. delegations at those Congresses recommended to their Federal Governments the appointment of an international commission to act in conjunction with the authorities of Mexico and Canada in adjudicating the conflicting rights which had arisen, or might thereafter arise, on streams of an international character.

The concept, although now deeply rooted, developed slowly over the next 7 years. In 1905 Canada and the United States, in taking what proved to be the first step in developing the concept, created the International Waterways Commission. The jurisdiction of this forerunner to the International Joint Commission was limited to boundary waters of the Great Lakes Basin. Mexico and the United States eventually formed a commission under a separate treaty.

During the following years, the Waterways Commission was involved with a number of matters of then current concern in the Great Lakes -- power and navigation works at Sault Ste. Marie, the preservation and enhancement of Niagara Falls, and water diversions into and out of the lakes to name only a few. It was purely an investigative body without power to act upon or enforce its decisions. Its most important accomplishment was its recommendation that the two Governments adopt principles of law to govern the uses of all of the international water between them and create an international body with the authority and jurisdiction necessary to study and regulate these waters. The recommendation undoubtedly reflected the Waterway Commission's concern with the need to resolve a number of troublesome controversies which were then simmering along the United States-Canadian border. These problem areas included a dispute regarding the use of the St. Marys River between Lakes Superior and Huron for power, a long-standing dispute concerning the water levels of Lake of the Woods, and a potentially dangerous situation between the citizens of Alberta and Montana involving the distribution of waters of the St. Mary and Milk Rivers for use in irrigation.

Negotiating the Boundary Waters Treaty proved to be difficult and time consuming. Although there was general agreement that a permanent commission should be created, the extent of its independence and jurisdiction involved considerable debate. The last and toughest of the issues that negotiators had to resolve was how the treaty would handle water diversions. The International Waterways Commission favored the principle that no diversion of waters crossing the boundary should be permitted in one country to the injury of public or private interests in the other. The United States negotiators, however, insisted upon the right of each country to do as it pleased within its own territory. The two Governments agreed on the latter view with certain limits, and a treaty was signed on January 11, 1909. It came into force on May 5, 1910 after exchange of ratifications in Washington, D.C.

The purposes of this unique instrument are set forth in the Preamble as follows ". . .to prevent disputes regarding the use of boundary waters and to settle all questions which are now pending between the United States and the Dominion of Canada involving the rights, obligations, or interests of either in relation to the other or to the inhabitants of the other along their common frontier, and to make provision for the adjustment and settlement of all such questions as may hereafter arise . . . ."

The Treaty provides for the establishment and maintenance of an International Joint Commission of the United States and Canada composed of three commissioners from each country. It gives the Commission three types of responsibilities. The first is defined in Articles III and IV and involves the approving of applications for the use, obstruction or diversion of boundary waters affecting levels or flows on the other side of the line (Article III) or obstructions of waters flowing from boundary waters or transboundary rivers downstream of the boundary which raise water levels on the other side of the line (Article IV). When granting such an

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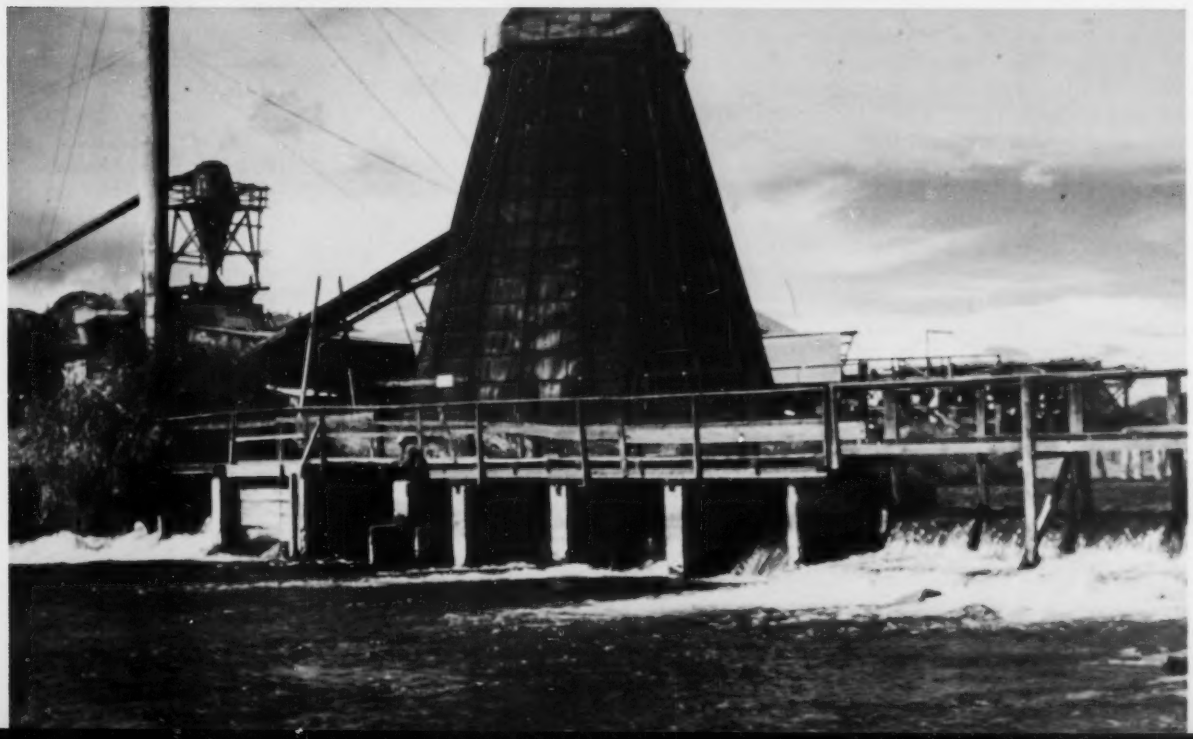
Mr. Fonda is the staff Engineer Adviser in the United States Section of the International Joint Commission.

The IJC also monitors the maintenance and operation of projects as small as this log structure, the Zosel Dam, on the Okanogon River in Washington. The old lumber mill, built by Mr. Zosel, at one time sawed logs that floated to the mill on pond behind the dam.



Canada and the U.S. assist the Commission by making available the services of qualified personnel of Federal agencies. The IJC is able to select and use the most experienced and competent people of both countries.

approval, the Commission imposes conditions to ensure that interests on the other side are protected or indemnified.

The second type of responsiblity, found in Article IX, is carried out at the request (called a reference) of either or both Governments. The Commission conducts investigations and studies of specific problems, reports back on the facts and circumstances, and recommends courses of action. Article IX also authorizes the IJC to coordinate or monitor programs and actions that result from governmental acceptance of its recommendations.

Article X of the Treaty sets forth the third type -- a judicial responsibility that has so far never been used. Under Article X, Canada and the United States may refer questions or differences to the IJC for decision rather than recommendations.

The Commission was duly formed by the two Governments and held its first meeting in Washington on January 12, 1912. Three weeks later, it adopted Rules of Procedure which were subsequently amended in 1964. These amended rules are still being used.

This semi-judicial body is made up of six commissioners, who are distinguished citizens with varied backgrounds. In the United States they are appointed by the President with the advice and consent of the Senate to serve at his pleasure. The requirement for Senate advice and consent to appointments was added in 1976 by the Congress. The Canadian Commissioners are appointed for varying terms by Order-In-Council (Prime Minister in consultation with his cabinet). Permanent offices are maintained in Ottawa and Washington, each having a small administrative and technical staff.

The work of the Commission is primarily carried out by international boards. Board members, who work part time on IJC matters, are selected and appointed by the Commissioners on the basis of their professional and personal competency. Although they normally are senior officials of major State, Provincial or Federal agencies and often bring with them considerable support from their agencies, the Commission expects to receive their best professional opinion on the case at hand, free from agency bias. Conversely, of course, the agencies are in no way bound by the opinion of a board member. The record of more than six decades of experience shows that this trust -- which is crucial to effective operation of the Commission -- is not misplaced. These boards are the backbone of the Commission, their principal advisors.

The Commission's staff experts assist it in interpreting the boards' advice, in preparing the Commission report to Governments, and, in rare instances of board disagreement on an action matter, in helping the Commission form its opinion on the proper action to be taken.

As problems are brought to the IJC for action, a docket number is assigned. In the 65 years since the Commission was formed, it has accumulated 105 dockets. So far, none of them have involved the 1,540-mile boundary between Alaska and the two adjoining Canadian Provinces. The matters of concern in these dockets range from the relatively simple problem of assuring proper maintenance and operation of a small log structure in the Okanogan River called Zosel Dam to the extremely complex task of monitoring the operation of the St.

The IJC is currently studying the feasibility of regulating the Richelieu River to alleviate extreme water conditions on the river and Lake Champlain. Its report is expected later this year.

Environment Canada

Lawrence River Power Project as it affects Lake Ontario and the St. Lawrence River water levels and flows.

Essentially, the Commission carries out its activities through the work of three types of boards: investigative, control and surveillance. Investigative boards, as the name implies, are used to study and report back on issues presented to the Commission. A reference or request from the Governments under Article IX, such as the 1965 reference on Regulation of Great Lakes Water Levels, resulted in an investigative board.

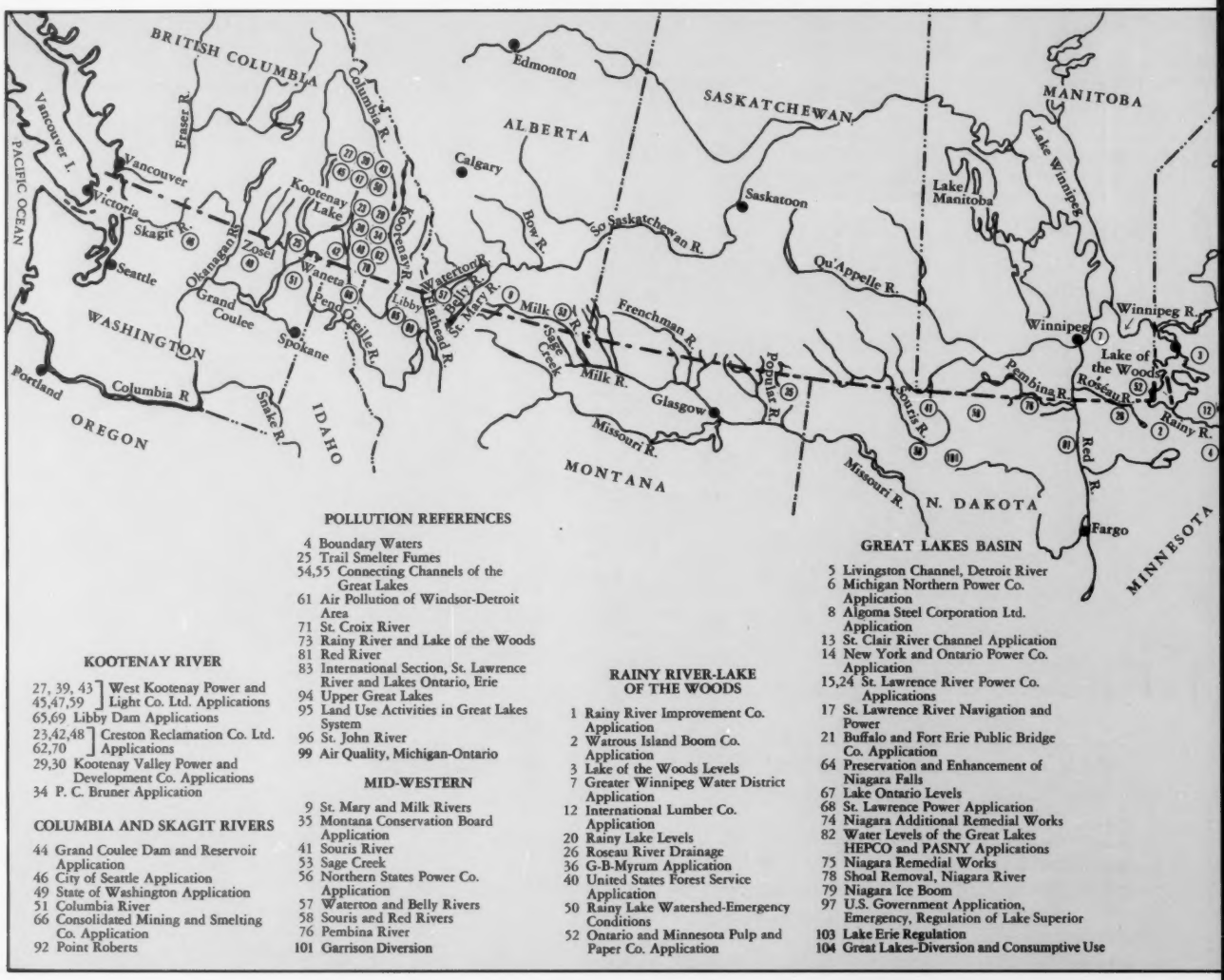
Control boards are normally formed to assure compliance with conditions of the Commission's orders approving use, obstruction or diversion of waters under Article III or IV of the Treaty. The International St. Croix River Board of Control, for instance, monitors the operation of dams and fishways on the St. Croix River to safeguard upstream and downstream interests and users of the water.

The third type, the surveillance board, is best characterized as a "watchdog." The IJC forms a surveillance board when it is requested in a reference from both Governments to provide a continuing overview of a potential problem along the border. The International Air Pollution Advisory Board, for example, was created in response to a request by the Governments to take note of air pollution problems, caused principally by industrial plants along the boundary, and also to draw appropriate problems to the attention of both Governments.

The United States and Canadian Governments have modified the provisions of the 1909 Treaty only once --

Bureau of Reclamation

The partially completed 73.6 mile McClusky Canal is part of the controversial Garrison diversion project in North Dakota, currently being studied by the Commission at the request of both Governments. If the project is completed, the diverted waters will irrigate 250,000 acres of North Dakota farmland.



POLLUTION REFERENCES

4 Boundary Waters
25 Trail Smelter Fumes
54,55 Connecting Channels of the Great Lakes
61 Air Pollution of Windsor-Detroit Area
71 St. Croix River
73 Rainy River and Lake of the Woods
81 Red River
83 International Section, St. Lawrence River and Lakes Ontario, Erie
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96 St. John River
99 Air Quality, Michigan-Ontario

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65,69 Libby Dam Applications
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29,30 Kootenay Valley Power and Development Co. Applications
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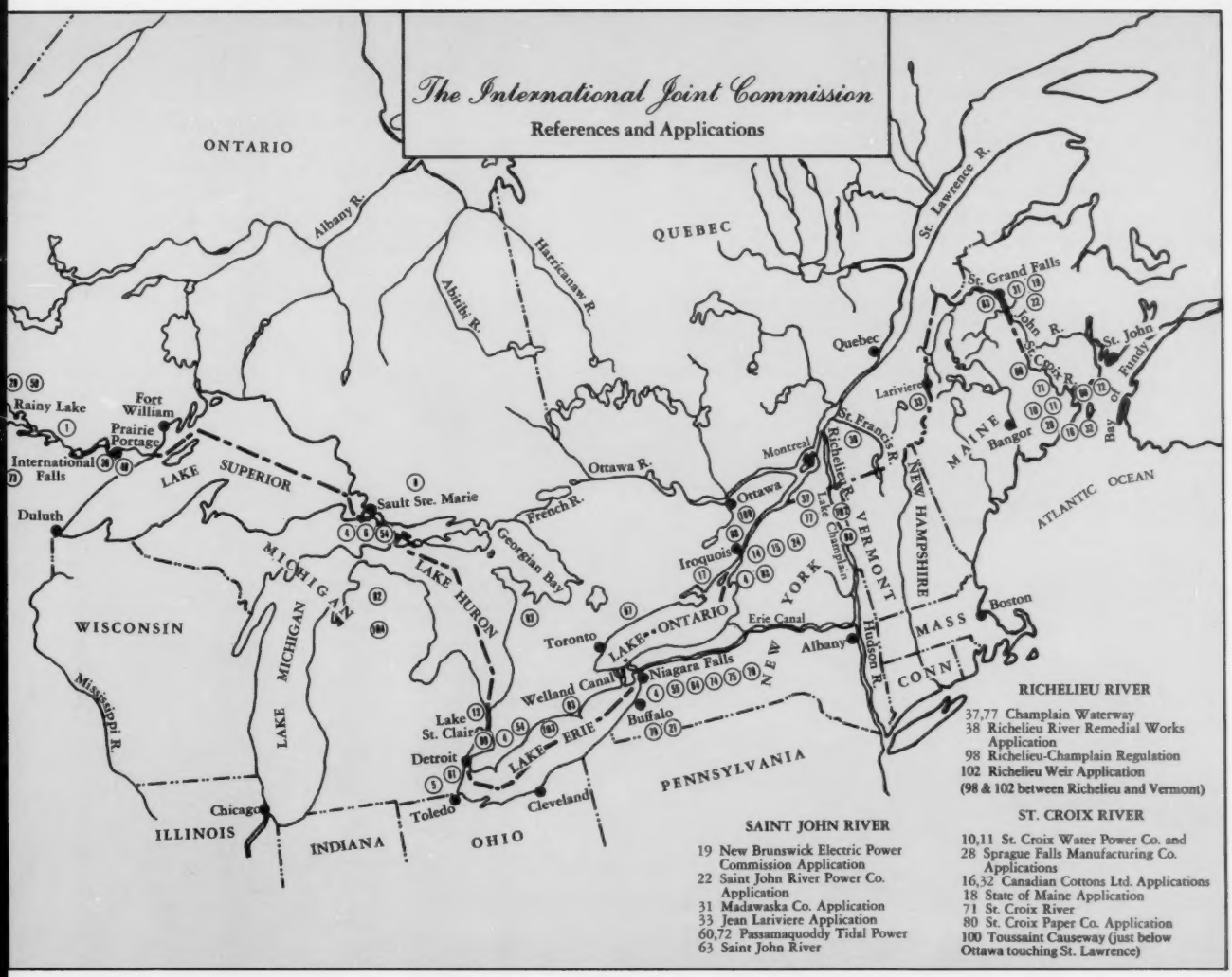
a change that added to the responsibilities of the Commission. It was done in the Niagara River Water Diversion Treaty of February 27, 1950 which, among other things, terminated certain provisions of the 1909 Treaty relating to Niagara River diversions. It was on the basis of the 1950 Treaty that the International Joint Commission was charged with supervising the design of remedial works necessary to enhance the beauty of Niagara Falls. These works distributed the waters of the Niagara River to produce an unbroken crestline on the Falls. The 1950 Treaty also specified the flows required over the Falls to maintain the scenic spectacle and indicated that the water made available for power purposes should be divided equally between Canada and the United States. The Treaty thus laid the groundwork for further development by both countries of the power potential of the Niagara River.

Article IV of the 1909 Treaty provides in part that "... the waters herein defined as boundary waters and waters flowing across the boundary shall not be polluted on either side to the injury of health and property on the other." On a number of occasions since the Treaty was signed, the Governments have requested the Commission to investigate and report upon pollution of boundary waters and waters flowing across the border. Prevalence of typhoid fever in the Great Lakes area prompted the first such reference in 1912.

A number of pollution references from the Governments followed over the years, involving boundary and transboundary waters over the length of the common border. In October 1964, Canada and the United States asked the Commission to determine whether pollution of Lakes Erie and Ontario and the international section of the St. Lawrence River was causing or was likely to cause injury to health and property on either side of the boundary. In the event of an affirmative answer to that question, the Commission was asked to determine the extent, causes and location of such pollution and what remedial measures could be taken.

In its report to the Governments in 1970, the Commission found that the waters referred to in the reference are being seriously polluted on both sides of the boundary



to the detriment of both countries -- enough to cause injury to health and property on the other side of the boundary. It recommended a comprehensive program of remedial actions and proposed water quality objectives for Lakes Erie and Ontario, the international section of the St. Lawrence River and the connecting channels of the Great Lakes. The Commission further recommended that the Governments of Canada and the United States agree on programs and measures to achieve the water quality objectives as well as schedules for their implementation.

On April 15, 1972, the Governments signed the Great Lakes Water Quality Agreement suggested by the Commission in its 1970 report. The Commission was asked to help implement the new agreement and to establish a Great Lakes Water Quality Board, which is principally a surveillance board, and a Great Lakes Research Advisory Board to assist with exercising the powers and responsibilities assigned to the Commission under the agreement. In addition, the Commission was given authority to establish a regional office in the Great Lakes Basin to assist in carrying out its own and the board's functions set forth in the agreement.

The regional office, which was established in Windsor, Ontario, has provided invaluable support to both the IJC and the Water Quality Board as well as assistance to other boards and committees formed to help implement the agreement's objectives.

The Commission reports yearly to the Federal, State and Provincial Governments in the Great Lakes Basin on its progress toward achieving the water quality objectives. The annual reports contain assessments of water quality improvements in the Great Lakes and evaluate the effectiveness of the programs and other measures called for in the agreement. The Commission also provides advice

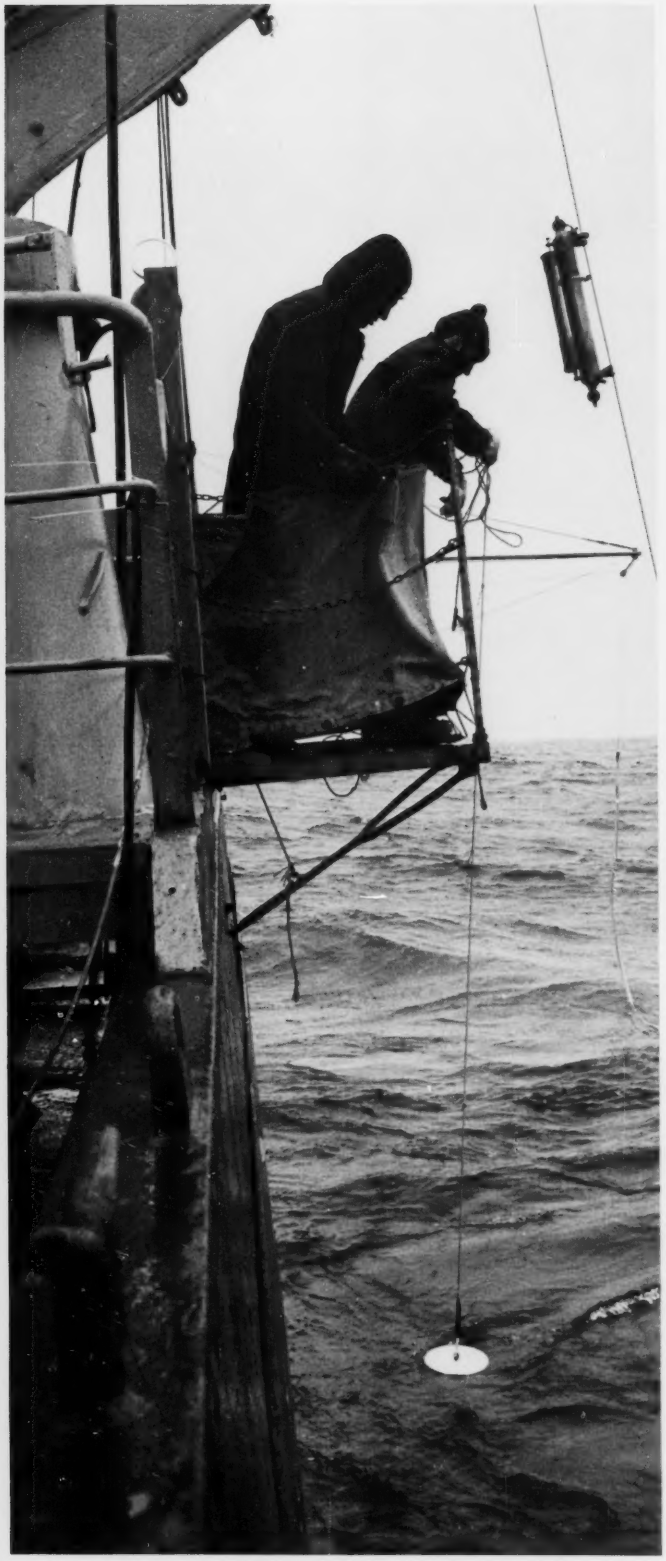
and recommendations on matters affecting water quality in the lakes.

The control and surveillance boards continuously monitor areas of Commission concern and responsibility along the United States-Canadian border. The geographic scope of their activities ranges from St. Croix River on the East Coast to Columbia River on the West. Theirs are the bread and butter tasks of assuring compliance with approved projects and keeping the Commission currently advised regarding areas of special concern.

The International Joint Commission, in addition to these ongoing activities, is currently engaged in a number of major investigations under references from the two Governments.

In October 1975, the Commission received a reference from the two Governments requesting an investigation and report on the potential transboundary effects of the completion and operation of the proposed U.S. Garrison Diversion Unit Irrigation Project. It was asked to recommend measures ". . .as might be taken to assist Govern-

Monitored by the Niagara River Control Board, the dike upriver of Canada's Horseshoe Falls helps maintain the flow required to enhance their beauty. Long low building near base of falls above is Canadian powerhouse. The water available for power is divided equally between the two countries.



Largest of the IJC boards with 18 members, the Water Quality Board is charged with monitoring progress toward improving the water quality of the Great Lakes.

ments in ensuring that the provisions of Article IV of the Boundary Waters Treaty are honored."

The project is designed to divert water for irrigation from the Missouri River basin in North Dakota to the north-central part of the State. This section is drained primarily by the Souris and Red Rivers which flow into Manitoba, causing concern about possible impacts of this drainage on Canadian water quality and quantity.

The IJC created the International Garrison Diversion Study Board to undertake the studies necessary for a response to the Governments. The board then held public hearings in Minot and Grand Forks, North Dakota and Winnipeg, Manitoba in November 1975 to receive testimony concerning the reference and its directive from the Commission.

The board gathered from interested Federal, State, Provincial and university organizations the expertise it required to resolve the complex questions. In various stages of the studies, 53 experts in several disciplines from 15 organizations were involved.

In December 1976, the board reported to the Commission, which made a wide public distribution of the board's report. After appropriate time for public review, the Commission held further hearings to receive public comment.

The Commission is currently preparing its response to the questions posed by the Governments, based on the report of its board and the comments received at the public hearings. The Commission, in turn, will furnish its report to the United States and Canadian Governments.

The IJC normally carries out its response to any reference in a manner very similar to that described for the Garrison reference. The specific procedures may vary somewhat, depending on the relative complexity of the study involved, but essentially the same steps are followed.

Also currently underway is a comprehensive study of the feasibility of regulating the Richelieu River to alleviate extreme water conditions on the river and Lake Champlain. Lake Champlain is located mostly in the States of New York and Vermont. The outlet of Lake Champlain, the Richelieu River, is almost entirely in Quebec and flows north from the lake for 80 miles to the St. Lawrence River at Sorel, Quebec.

Flooding over the years has caused considerable damage to shoreline owners on the lake and river. Those affected by this flooding have urged that works be completed in the Richelieu River to permit outflow regulation to lower the high water levels on the lake and river. Since Lake Champlain supports diverse and valuable wildlife and fisheries, there is considerable concern that regulation will not unduly affect this resource. Board studies are well underway and its report to the Commission is expected in late 1977.

The Commission is also completing a report to both Governments concerning the apportionment of waters of the Poplar River, which flows from Saskatchewan Province into Montana. When development begins on a transboundary stream such as the Poplar River, demand for its water in both countries can soon outstrip available supplies. It is, therefore, important that when impending development is foreseen that could strain water supplies of such a transboundary river, an apportionment be de-

Just upstream of the highway and railroad bridges are the Sault Ste. Marie control gates on St. Marys River. Under the control of the IJC these gates, along with the water allotted to power plants and navigation locks, completely regulate the outflow of Lake Superior.

David Chenoweth

veloped for the flows from the upstream country. Such an apportionment provides the foundation for continuing development by each country of its share of the basin water resources. The Commission's report will provide a basis for the Governments to determine an allocation of the Poplar River's waters.

The United States and Canada have recently given three new references to the IJC. They have asked it to study and report upon the effects of diversion and consumptive use and their impact on management of water levels and flows of the Great Lakes Basin; to determine the possibilities for limited regulation of Lake Erie; and to look into possible improvement of the meteorological, hydrologic and hydraulic network in the Great Lakes Basin.

Each of the new references involves issues of major concern. Boards have been formed by the Commission to carry out the necessary studies to respond to the first two references. A plan to proceed with the third is currently being considered.

The concept of this independent commission, with a broad charter to examine problems between two countries and suggest solutions based on practical equity, has worked well for Canada and the United States. The leaders of both countries have consistently pointed to the Commission's success in defusing touchy situations along the border. President Franklin D. Roosevelt probably voiced the common view when he said: "The establishment of the International Joint Commission was unquestionably one of the most notable steps taken by the United States and Canada in their continuous efforts toward eliminating causes of possible friction between the two countries."

In the past decade, the pace of the Commission has quickened perceptibly. It has been deeply involved in the issues of water and air pollution which are of increasing concern to the peoples of both countries. The IJC looks forward to new challenges in coming years as the natural growth of both countries intensifies and complicates the interaction on their borders. ■

River Raft Revue

by **Graham Paul**
Otrabanda Company
Photos by Susan Horowitz

Showboats on the Mississippi--the phrase conjures up stately theaters floating along the Nation's biggest river, bringing "culture" to river towns and cities. That nostalgic image is of a time when the river served the people who lived along its banks as their principal means of communication, transportation and excitement.

For the last four summers, however, a professional theater group called Otrabanda Company has been continuing the tradition of the showboats -- not as a revival of a romanticized past but as a contemporary addition to life on the Mississippi. This season, the ten troupe members, all of us former drama students at Antioch College, are again touring the Mississippi, bringing a travelling tent show called "The River Raft Revue" to small towns, large cities and prisons from St. Louis to New Orleans.

At first sight, the connection between the enormous floating palaces of the 19th century and Otrabanda's mode of travel may seem obscure. Supported by contributions from varied sources, we travel from town to town on a small home-made raft that is powered only by the current and a small outboard motor. (The motor was added to the 12 by 15 foot raft when last summer's low-flow current could not keep up with the company's performance schedule.) On this raft we live, eat, converse and get to know the Mississippi as few people can today.

We have come to know the river as few people can today.

Some people from Grand Tower, Ill., are helping us put the raft together for our annual river tour. They knew a lot more about boats than we did.

Coming ashore is sometimes more difficult than staying afloat on the great river.

Here we are tied up at a dock in Helena, Ark. A local resident, sitting on his raft, is telling us stories of his adventures on the Mississippi.

Many of the Mississippi's commercial vessels soon became a familiar sight to us.

The night before we reached Cairo, we stopped upriver with some fishermen (Big Red and his friends), while they cleaned fish on table in foreground. We value these opportunities to meet people from river towns and renew friendships from year to year.

From year to year we follow the same routine. While our company is floating down the river, a brightly decorated van and trailer is being driven to our next location. It carries props, costumes, musical instruments and, most important, the large red and yellow circus tent in which the company will perform.

As our raft approaches the next town in which a performance is scheduled, a group of children -- and occasionally adults -- is usually waiting to meet us. We are greeted with shouts and questions: "You doin' the same show as last year?" or "Do you really travel on that thing?" The answer to the first question is no; every year it's a new show. The answer to the second is an enthusiastic yes.

After the raft is secured, our troupe is taken into local homes where we will stay while we're in town. For members of the company, one of the most pleasing parts of the tour is the opportunity to get to know people in the river towns and to renew friendships from previous years. It's an important aspect of the personal contact which exemplifies the river tour.

The day following our arrival is spent putting up the tent and preparing for the evening's performance, all with plenty of help from the kids. There are impromptu unicycle and juggling lessons, general playing around, and lots of conversation about the river and the raft. Older folks will come by to talk about working on the river or about the dance boat that used to go up to Cairo. Kids will ask if they can come along when the raft heads on downstream. And there are questions about the show: "How much does it cost?" "It's free." "Free? I'll be there for sure!"

In the evening, before the performance, the band (all the actors double as musicians) plays a few tunes while members of the company ride unicycles, walk on stilts and talk to the crowd. There's a special pre-show tight-wire act with a blindfolded finish, and then it's time for the show.

"The River Raft Revue" changes every year, but it's usually a series of acts with a heavy emphasis on music,

A crowd is gathering around the show tent on the Miami River bank at Dayton, Ohio. We're trying to expand our tour to other rivers of the inland waterways.

We had pulled up to the shore near Mayersville, Miss., where we camped for the night.

laughter and fun. Last year, for example, there was slapstick humor, social satire (the Corps of Engineers had the dubious honor of being the subject of one particular act), pantomime, dance, and local and topical jokes.

All the material is developed by the company and stresses the relationship of that particular town to the river and to other towns along the river. People seem to enjoy being reminded that there is something special about their lives and the place they live; and for people in these towns, the river is an important aspect of that specialness.

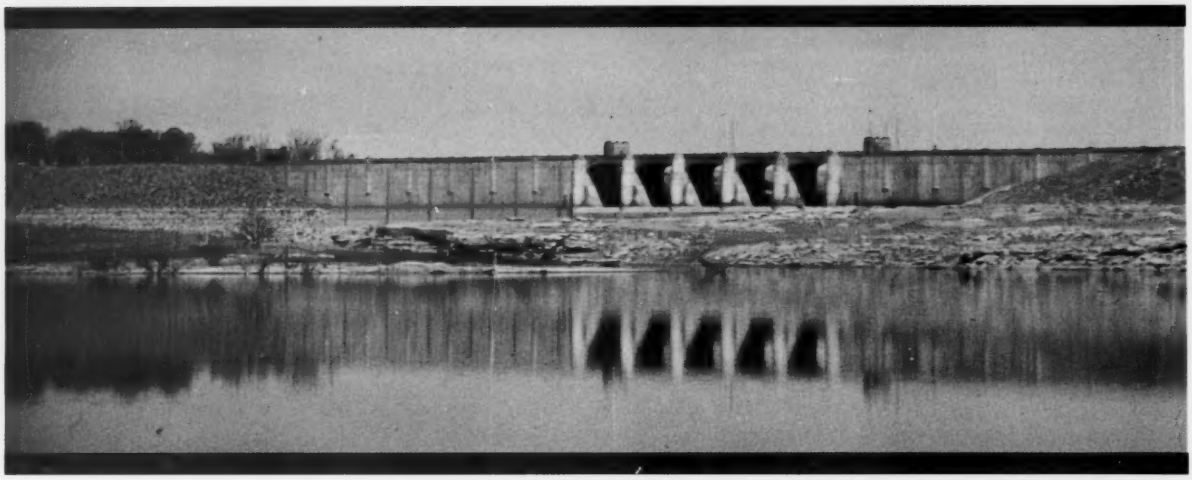
After the show is over and the hat is passed (several hats actually), the tent is struck, again with lots of help. Then, following another night of hospitality, we return to the raft, wave good-by to friends on the shore and push into the current. The river sweeps our band of performers out of sight and on toward the next stop.

This summer, Otrabanda will be traveling the Mississippi in August and September. We are also trying to expand the tour to other rivers of the inland waterways. Off-season, the company often leaves its New Orleans headquarters to perform in theaters throughout the country.

Our group has received support from the National Endowment for the Arts and various State arts councils for each of our five tours. City councils, civic groups, individuals, and river-based industries and towing companies have also given us financial assistance. This kind of support has enabled us to keep the admission at its current popular price -- free, an anti-inflationary program if there ever was one.

Perhaps, sometime, Otrabanda Company's modest raft will expand into a full-fledged showboat, and we will have a floating palace of our own. But large or small, the aim will remain the same -- providing quality, professional theater to the people living along the banks of the Mississippi River. ■

RESPONSE TO DROUGHT



by **Robert Harrison**

Drought is a great reminder of our weakness in the face of the extremes of nature. Fortunately, these extremes also trigger the marvelous social capacity of our society for speedy and innovative actions -- actions to help reduce the impact and assist the victims of disaster over the crisis and along the road of rebuilding. Such efforts are underway in the West and Northwest to help people there through the severe drought they are enduring.

Much of the western and central United States was dry throughout 1976. By late winter, the potential for a severe drought was clearly seen. In September 1976, the lower Mississippi River was at its lowest flow in 200 or more years of record keeping. The lower Mississippi drains more than 42 percent of the United States, so this low water indicated that rainfall was below average over a large part of the Nation. The water table in parts of Wisconsin, Minnesota and Michigan declined to record or near record lows. When normal snowfall failed to come over the western mountains, it was clear that areas of acute water shortage would develop unless spring rainfall was exceptional. Thus, the present emergency developed over a number of months, giving time to plan adjustments to cope with water shortage and, in some instances, to overcome the shortage through engineering or management approaches.

Impacts

It is difficult to overestimate the effect severe and prolonged drought can have on agricultural communities, industry and urban centers. Sustained drought conditions in the past have resulted in abandonment of agriculture and settlement in many parts of the globe. Most Americans know of the tremendous economic and social distress caused by the drought of the 1930s when the topsoil in our midwestern States dried to dust and spread across most of the United States and far beyond. The social impacts affected a whole generation of Americans wherever they lived and however they made their living. The water shortage in New York City in the 1960s is also vividly remembered by all who lived through it.

Drought, and the expectations of drought, first brings to mind the water needed for essential household use and for cattle and crops. Water for industry is usually not the first concern, possibly because many of the industries using a great deal of water have developed relatively secure supplies of their own.

Present conditions threaten the adequacy of many community water supplies. California, for example, listed 50 communities as water-short in December 1976. In spring, the situation worsened in most instances. Of the 10,000 public water supply systems in the Northwest, 200 are expected to require substantial changes in use patterns in 1977 or else run out of water. Some communities are already curtailing water use.

The effects on agriculture, both irrigated and dry land, vary greatly from community to community, even within the areas of severe water shortage. The low flow conditions experienced in California in 1976 were generally not too damaging to agriculture due to the above average reservoir storage carryover from 1975, plus the availability of groundwater from wells in many areas. Crop losses in 1976 were not severe and were mainly in fruit and nut crops. In 1977, however, available water supplies

Mr. Harrison is senior economist at the U.S. Army Corps of Engineers Institute for Water Resources, Fort Belvoir, Virginia.

Tucumcari, N. Mex. area is irrigated by water from the Conchas Reservoir (left). Note the dark line along base of dam that indicates the normal water level.

in northern California are expected to be no more than 50 percent of normal. The absence of normal carryover storage will also be felt in Washington, Oregon and Idaho. Many farmers depending on irrigation will be short of water; reductions of 50 percent will not be unusual; and both annual and perennial crops may be difficult to keep alive.

The shortage of water for agriculture, although most serious for individual farmers and communities, is not expected to materially affect overall U.S. supplies and prices. It is anticipated that any deficiency in supplies from the drought areas can be made up from other places.

Maintenance of adequate water for livestock will require many in the West and Northwest to haul water to their farms, as farmers in Marin County, California already have been doing for several months. This reflects the poor water supplies of thousands of farmers who rely on shallow wells. It is difficult in many regions to get wells deepened or new ones dug during this period because of the shortage of experienced well drillers and equipment.

Damage to dry land agriculture, which contributes about 80 percent of the West's acreage and 50 percent of its food production, may prove to be the greatest impact of the 1977 drought. The U.S. Department of Agriculture has observed that low soil moisture conditions throughout the 17 western States are of critical importance for two reasons: large areas are exposed to wind erosion, and forthcoming crops are more dependent on the amount and distribution of rainfall during the growing seasons. Considering the present low soil moisture conditions and assuming normal summer rainfall, dry land production is expected to range from 50 to 60 percent of normal during the 1977 season. Direct losses from drought-related damage may reach $7 to 10 billion this year.

While it is natural to think of drought first in terms of water for communities and farms, there are many other important impacts of drought -- some with long-range consequences. Low flow in streams and low water levels in lakes seriously affect fish and wildlife -- in many cases disastrously.

Drought also means that hydroelectric power may have to be curtailed to save water for more urgent needs. For example, in 1976, California's hydroelectric facilities generated about 10 billion kilowatts of electricity less than normal because some of the water was diverted from power production to other uses. In Washington and Oregon, reduction has resulted in some job losses in the aluminum industry, which is a heavy user of the low cost power. A power grid that ties all electric producers into a system has so far made it possible to avoid any serious power shortages due to the curtailments of hydroelectric production.

Another result of drought which may be overlooked is the influence of low flow on inland navigation. Navigation difficulties have already developed in the Sacramento River due to low water levels. In 1977, inland navigation in the Northwest may be affected by low water in the Columbia and other rivers.

Fire hazards, both urban and rural, greatly increase during dry periods. In urban areas, firefighting can significantly reduce water supplies. Forests may be closed during droughts in the interest of fire prevention. This can seriously affect employment in the logging industry. Grassland fires can also be very destructive.

Soil Conservation Service

Measures to conserve irrigation water should include the long-term modernization of older irrigation systems, particularly those built before the 1950s. They typically lose one-fourth or more of diverted water through leakage.

An entire generation was affected by the economic and social impacts of the great "dust bowl" drought of the 1930s.

Health is another important consideration when dealing with drought. Low water supplies can easily become contaminated, and constant attention is needed to prevent this. It is not unusual for farm families to have to boil water when wells become very low and somewhat stagnant. City water systems must be carefully checked at these times, particularly when water pressure is low or is temporarily lost.

Managers

While seasonal droughts are rather common, most do not assume national importance and have only a limited impact on the overall economy. The present situation is largely a matter for State and regional authorities, as is generally the case. Although droughts are not managed from Washington, the Federal Government ordinarily provides financial assistance to affected areas. More than a dozen Federal agencies, as well as emergency relief organizations, are involved.

Effective water management must come from individuals and local officials who know the situation and are in a position to take timely action, although interstate or regional coordination may become desirable, even essential. The responsibility of individuals and communities for their own water supplies is a long established practice in this country and indeed throughout the world. Communities cannot depend on the State or other cities to supply them in emergencies; only in a dire crisis will outside authorities take control of local systems.

Local initiative is the key to drought management. Anyone who has ever lived through a serious drought knows that the weight of responsibility on local officials and individuals is very great. The States, counties and cities of California and the Northwest have moved decisively to define local problems, develop plans to operate storage and distribution systems for optimum use of available supplies, introduce water conservation measures, and to inform Federal and regional agencies of their problems and needs.

Federal agencies have likewise taken steps to assist the States and counties. As noted earlier, hydroelectric power facilities have been adjusted to meet other needs for water. The Federal agencies supplying irrigation water have cooperated to develop techniques that closely match deliveries to crop water requirements. Water from Federal reservoirs has been released on schedules which contribute to the best management of fish and wildlife. Their efforts have added up to an effective program for making the best use of limited water supplies and for easing the impacts of drought.

Measures

Programs to conserve water are not simple. The 1976-77 water conservation program underway in the western drought areas has been carefully planned by specialists from several fields of engineering and by social scientists.

Once the facts about supplies are clearly established and the feasibility of possible transfers are known, the success of such a program depends on how well the full participation of the public is achieved and motivated. At its best, a water conservation program can awaken the vast reservoir of ingenuity that is characteristic of the American public and use it to save water and find new sources. On the other hand, a conservation program that is not well planned can backfire and become a source of damaging charges and counter charges among water users who feel they are not being fairly treated, are the only ones asked to save, and are bearing all the sacrifices. Lessons from past experience with drought are paying off today in programs which are remarkably successful in generating high levels of public interest and participation in California and the Northwest.

Local officials and individuals must develop plans for optimum use of available water supplies during times of drought.

When considering the impact of possible conservation measures, it should be recognized that about 83 percent of water withdrawals in the West is for irrigation, about 8 percent for municipal and industrial use, and about 9 percent for all other uses. Clearly, the potential savings from conservation programs directed at irrigated agriculture are great; but they may not produce quick results because many of the techniques for saving water require that farmers and irrigation districts invest substantial sums in improving and altering their systems.

The operation of canals and laterals, for example, usually results in some waste -- 3 to 15 percent depending on the age of the system -- because flows do not always equal demand. Also, leakage in some systems is significant, particularly in those constructed prior to the 1950s. They typically lose one-fourth or more of diversions. The cost of modernizing old systems ranges from $300 to $700 an acre. Clearly, only the most urgent alterations could be made in time to significantly affect the current drought. The many steps which drought administrators have outlined for saving irrigation water include those that can be done quickly and cheaply, as well as those requiring investments which would have effect over a period of 10 to 15 years.

Residential water conservation is important because it frequently enables communities to carry on most normal activities while avoiding the great cost of hauling water, building pipelines or taking other drastic and expensive measures. In this year's drought areas, per capita consumption of water is about 200 gallons a day. An effective conservation program should be able to halve this consumption without undue hardship by reducing water used in activities such as lawn sprinkling, car washing and filling swimming pools. In Marin County, California, the Municipal Water District, which has little industrial use, was able to reduce per capita consumption by 65 percent. It doubled the water rate and imposed stiff penalties for water use in excess of the lifeline rate, a base quantity required for household facilities.

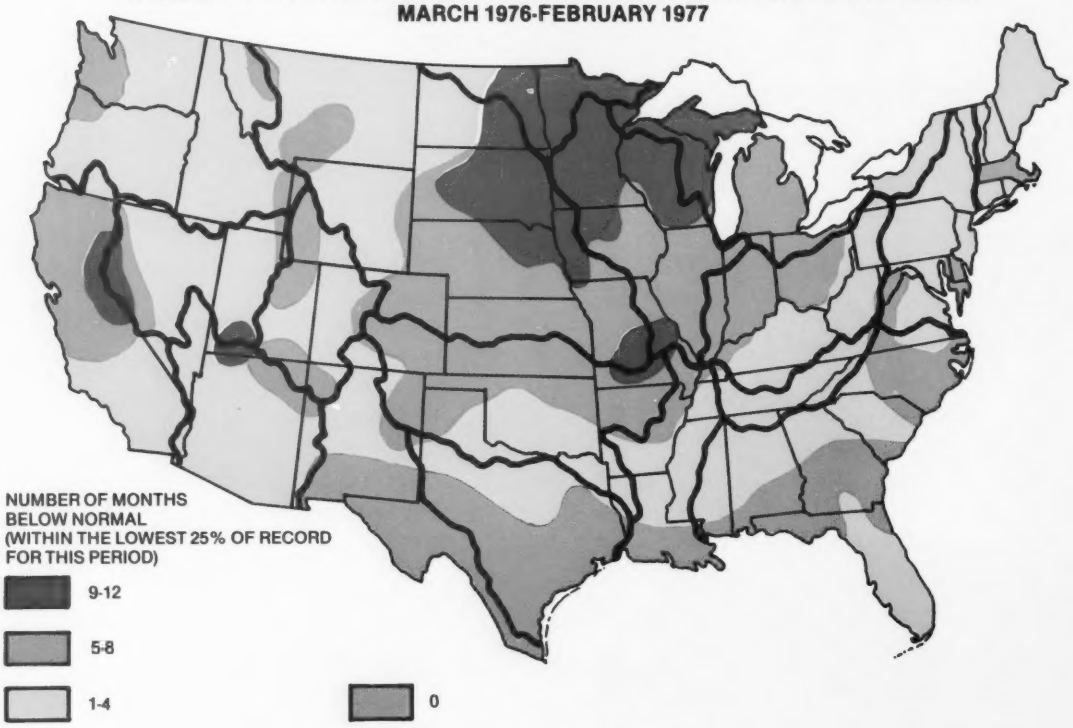
Industries have also been able to save water by applying conservation techniques. The Department of Commerce found that industries drawing water from the municipal system in California could reduce water use by 25 percent without incurring substantial economic hardship.

Water managers during time of drought should not overlook the possibility of temporarily increasing the water supply. In many affected areas, substantial quantities of groundwater exist. Farmers in the central valley of California have turned to wells to tap this supply -- an estimated 8,000 have been drilled to obtain needed water. In addition to new wells, those that were closed because of land subsidence and for other reasons are being reopened.

During periods of drought, however, there may not be time to learn the size of underground reservoirs by selective pumping. This suggests that emphasis should be placed on conjunctive use of ground and surface water during normal times.

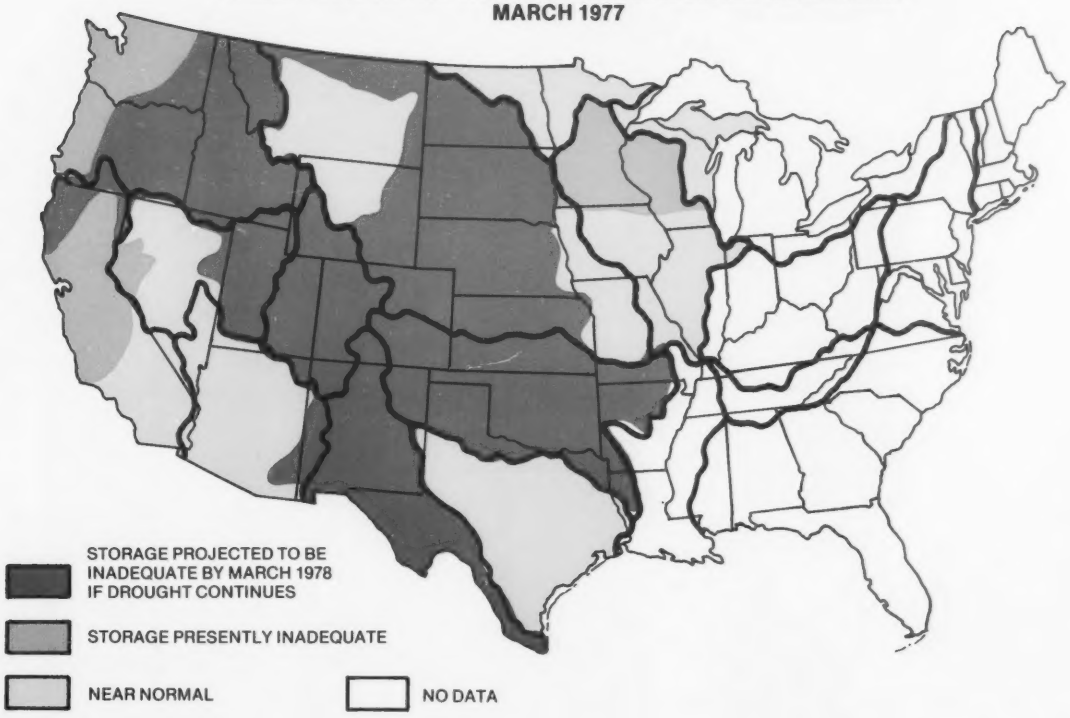
Cloud seeding may be possible to increase snowpack

NUMBER OF MONTHS OF BELOW-NORMAL STREAMFLOW DURING THE PERIOD: MARCH 1976-FEBRUARY 1977

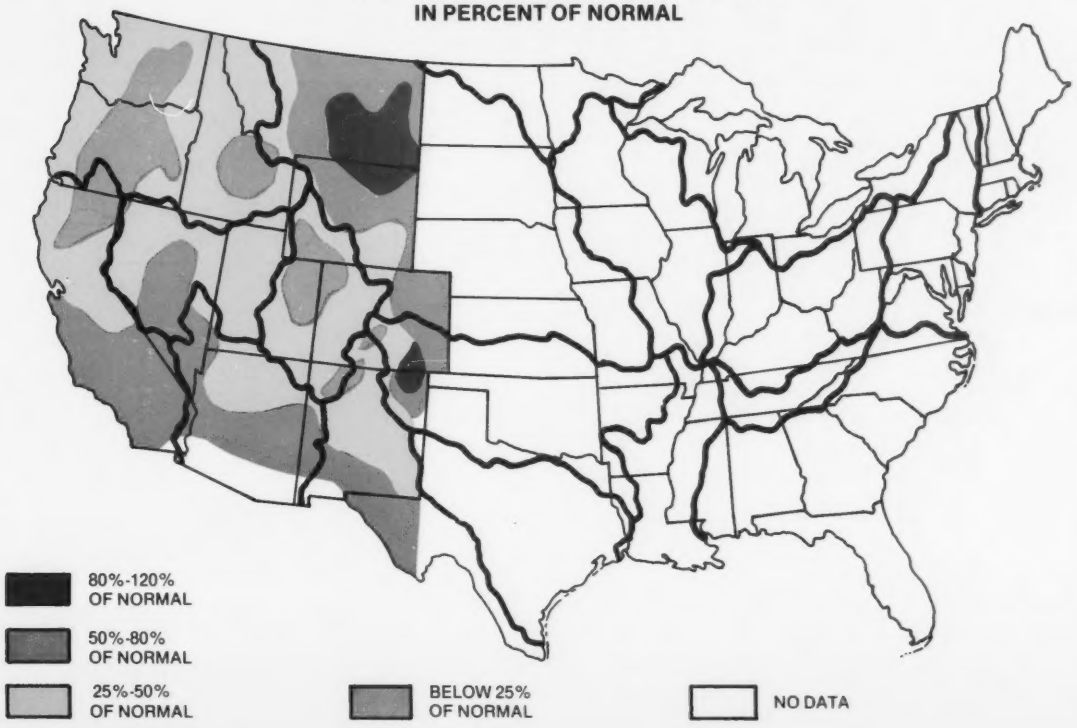


SELECTED WATER RESOURCE REGIONS AND SUBREGIONS OF CRITICAL CONCERN

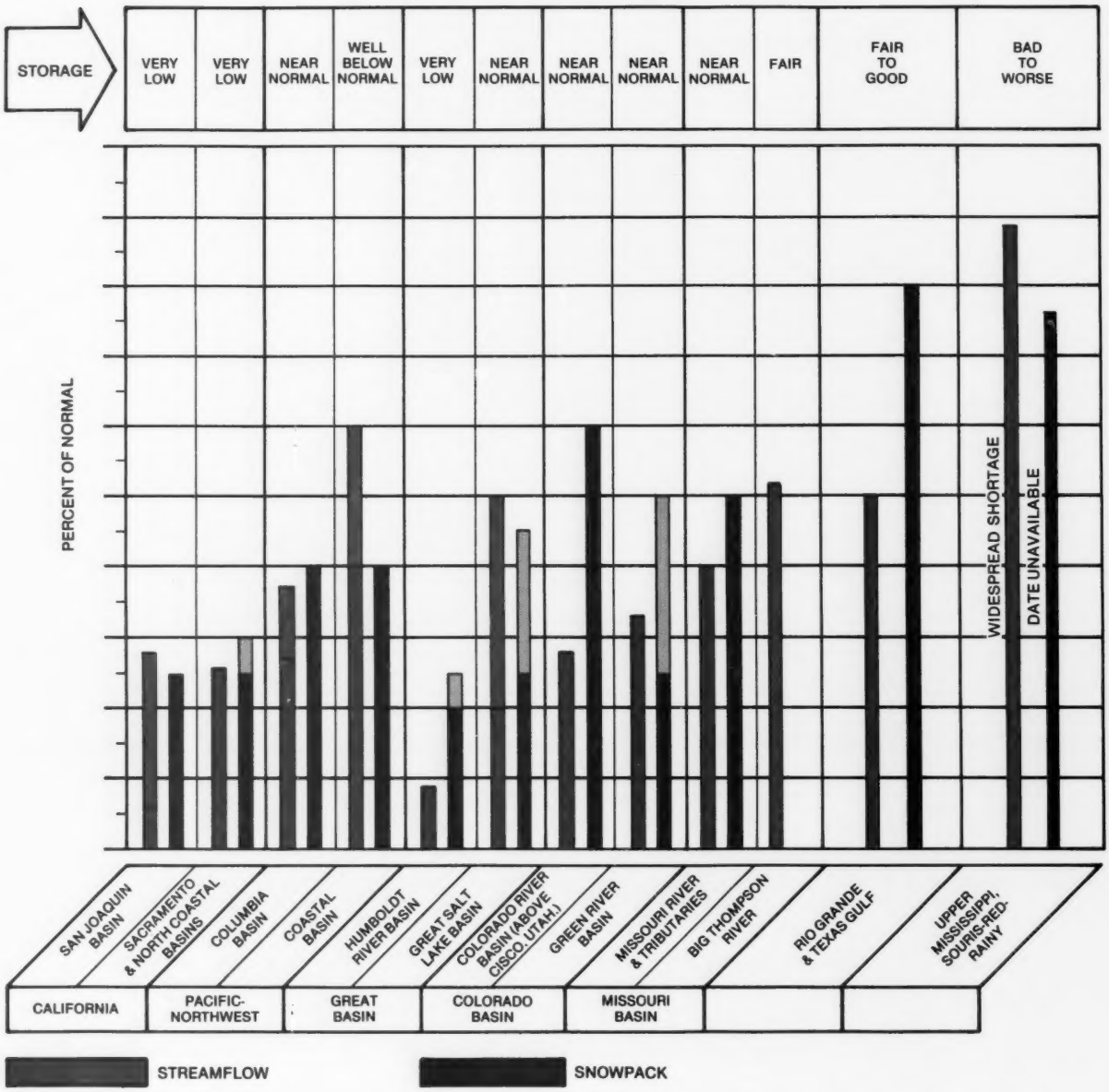
PRESENT AND ANTICIPATED RESERVOIR STORAGE CONDITIONS
MARCH 1977


STORAGE PROJECTED TO BE INADEQUATE BY MARCH 1978 IF DROUGHT CONTINUES
STORAGE PRESENTLY INADEQUATE
NEAR NORMAL
NO DATA

PRECIPITATION FROM OCTOBER 1-MARCH 1
IN PERCENT OF NORMAL



STREAM, SNOWPACK AND STORAGE OUTLOOK



and, in some instances, to obtain limited summer rainfall. Obviously, in parched areas the opportunities for increasing the water supply are limited. Thus, most measures are constrained to management, reallocation and redistribution of existing sources and establishing the priority to be accorded different uses.

Reallocation efforts in the West have been hampered, however, by the Law of Water Rights. As it has developed in the western States, the law does a good job in securing the lawful user of water in his rights. When there is normal flow, this system works well; but in time of drought it can make effective water management difficult indeed. The order or priority of use of the water in western reservoirs is controlled by ownership, by use rights and in other formal ways. This leaves little room for reallocation even to satisfy important needs. The water law of most of the western States makes it difficult, even impossible, for the owner of an irrigation water right to transfer it to someone who needs water for another purpose at another location. The present drought has shown the need for various changes in the Federal and State water laws.

Learning from Drought

From drought experiences, water resource planners and hydrologic designers learn how to produce more robust and resilient water resource systems. In the United States and most other countries, rainfall and other basic water resource records cover very short periods of time and thus are an uncertain basis for water resource plans. Not only are basic records insufficient for the planning task, but the way by which climate variables affect yields are not known for many crops and localities.

Climate forecasters and crop specialists are just beginning to work together to give water resource planners some of the data they must have to make adequate plans; but such guides to the effects of climatic variability by crop, soil type, and management practices can be achieved in the early future. In the meantime, climatologists can make better estimates of climatic variability and drought probabilities through paleoclimatic research. This knowledge will help emphasize the need for built-in reserves and flexibility in water supply systems in potential drought areas.

An important impediment to building better water supply systems is the scarcity of information available on the sociology and economics of drought. Responses to drought deserve careful observation and analysis. This would lead to better knowledge of economic and social impacts, how they are shifted throughout the society, and on whom they ultimately fall. Such information would make it possible to determine whether the solutions imposed during water shortages are optimal approaches for the community. In the study of alternative solutions, the problems caused by water laws would be an important aspect to be investigated.

As water resource planners obtain better data on the variability of climate and on the scope and nature of climatic change, a framework showing expected socioeconomic activity by sectors and regions could be designed. It would give a good picture of the water needs of each, including estimates of elasticity in the demand for water. Such a national picture of comparative water demands would make possible a truly sophisticated adjustment to drought and to changes of the type which occur when additional irrigation development is needed in areas of dry farming.

Federal Roles

While water supplies are largely a local responsibility, it is important to recognize that serious droughts set in motion certain long-run actions in which the Federal Government plays an important, perhaps a decisive role. Engineering and management approaches to water resource use, with their development and conservation objectives, ordinarily take many years to bring to a state of full usefulness. Leadership in such plans logically falls within the responsibility of the Federal Government.

Water resource developments are most effective when carried out on the basis of major river basins. Thus, there are often interstate and even international problems involved in water resource planning. The role of interbasin transfers of water is of growing concern in the context of the Nation's evolving energy program, as well as in the context of drought.

As we learn more about the patterns of climate variability and the dynamics of climatic change on the country's water supplies, the combined efforts of the States and Federal Government to understand water resource needs, development plans and designs will be even more evident.

As a result of the present drought, we can say with confidence that the alert and effective actions of the States, counties and local communities justify, at least in part, the efforts which have been made over the past 10 years by the Federal Government. It has helped each State build up firm knowledge and experience in the development and operation of water resource projects, programs and policies. Droughts in the years ahead promise to be increasingly manageable -- merely inconvenient rather than crippling. ■

Events, Deeds & Deliberations

A Move to Save the Wagon Works

by **Perry Stirling**
Chief, Public Affairs Office
Philadelphia District

The Army Corps of Engineers recently completed its biggest preservation project ever when the Philadelphia District relocated historic Gruber Wagon Works away from the future site of Blue Marsh Lake.

Planning for the move started back in 1974 when construction began on Blue Marsh Dam and the Corps purchased the works. They hoped to find another site for the factory and to repair the aging structure. Fearing vandalism and theft, Corps employees inventoried and stored everything that could be moved out of the building. The precise location of 19,000 items, including hand tools, machine parts and materials, was recorded. Architectural drawings of the entire building were made in preparation for the move so that the factory could be rebuilt exactly as it then stood.

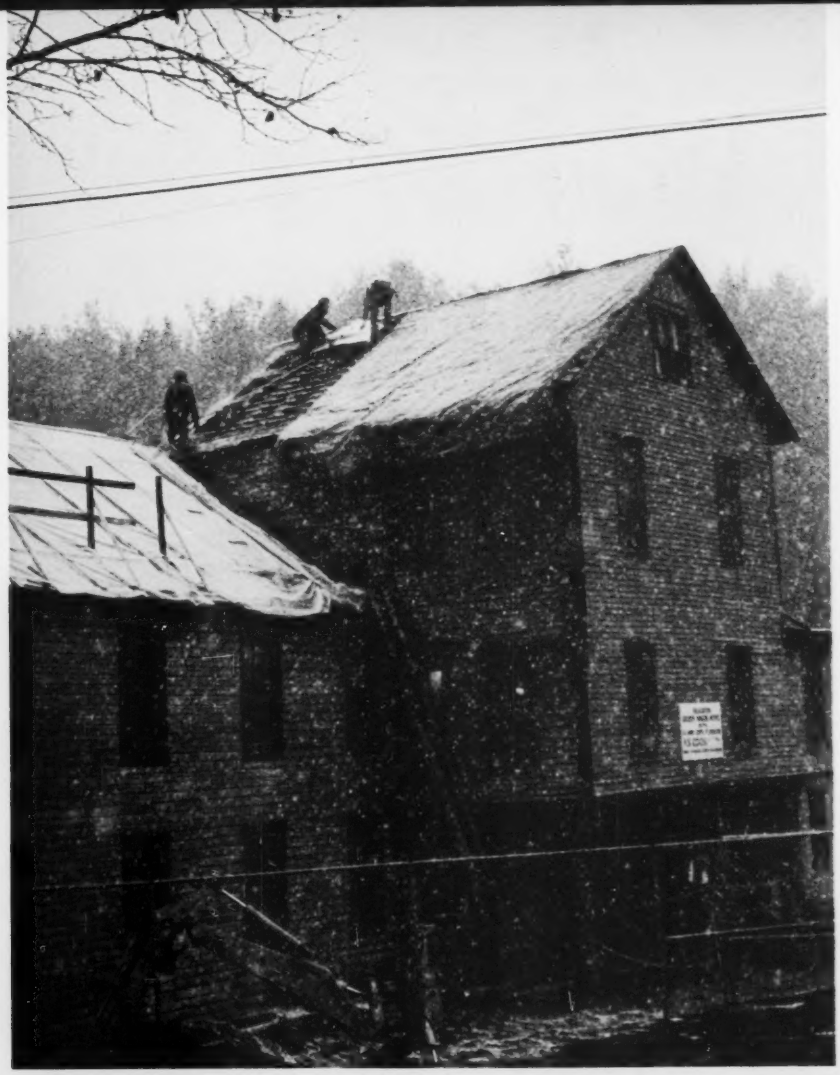
Finally, in mid-November 1976, after Congress specifically authorized the relocation project in the Water Resources Development Act, the work began. Crews of carpenters and building experts under contract to the Corps began swarming over, through and under the three-story wooden structure. They built stud walls throughout the interior for structural bracing, separated floorboards in a missing tooth pattern, dug underneath the building to shore and place steel beams, and divided it into several sections.

Section four, a 42 by 17 foot, one-story addition to the blacksmith shop built in 1910, was carefully trundled down the country highway about a week after the first small sections had been relocated.

The largest component, section two, was one of the next to be pulled away from its foundation, but only by a few inches. Measuring 26 feet in width, 40 feet in height, and 71 feet in length and weighing about 86 tons, this section was scheduled to be moved on December 7.

But the 7th came in to the beat of a wind-whipped rain that lashed the area into a muddy quagmire. The

The first day's work begins by checking drawings for the delicate job of separating the old wagon works.

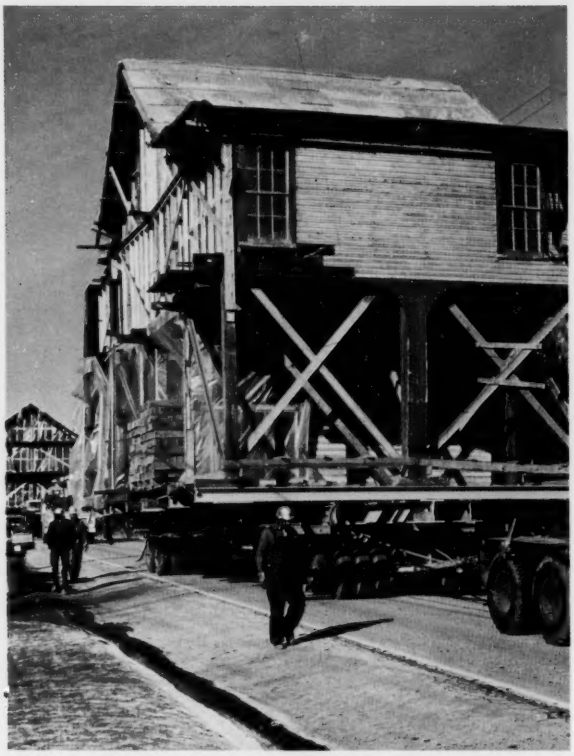


The wind-whipped snows of a Pennsylvania winter buffet carpenters who are covering the exposed roof beams.

Looking more like a coal miner, this mover prepares to thread steel support beams under the building.

The largest component, section two, is pulled slowly and very carefully onto Route 183 to begin its 6-hour trip to the new site.

Alone with his thoughts, Franklin P. Gruber, 93-year old grandson of the Wagon Works' founder, watches relocation begin.



Traffic is halted as the last two sections are trucked 5 miles to Tupehocken Creek Park, near Reading.

downpour slackened during the day, changed to snow flurries as the temperature plunged, and finally ended. The forecast for December 8 predicted clear and colder weather.

The forecast was correct. Shortly after dawn, the largest section, 86 tons of American industrial history, began the five-mile, six-hour trip down a traffic-free highway to its new home at Tupehocken Creek Park, near Reading. The site was made available by Berks County, which will be responsible for maintaining the restored works as a public museum.

One week later, the remaining sections were moved to the new site. After they were rejoined, the original wall was rebuilt under the wagon works.

The historical significance of the Gruber Wagon Works made this detailed effort worthwhile. Built in 1882, the structure is perhaps the best existing example of a late-19th century rural manufactory. Robert M. Vogel, head of the Smithsonian Institution's National Museum of History and Technology, said: "While there are a number of small 19th century factories in the United States that survive with their machinery and other equipment intact, I know of no other where this is true to the extent that it is at Gruber's. . .(It) is nothing less than a three-dimensional document of one particular American industry, fixed within a particular, narrow time frame."

The next effort will be the restoration of the works. When it is finished next summer, it will look to the visitors strolling through as if a properly trained crew could walk in and immediately start making wagons again. A fragment of history will have been preserved for tomorrow.■

Water Spectrum Wins Top Award

The Society for Technical Communication recently selected *Water Spectrum* for its first place award in Complete Periodicals Category in their Eighth International Competition. The Society is composed of editors and writers who work on technical publications in industry, commerce and government in the United States and Canada. This award for outstanding achievement in communication is based on relevance, quality and overall excellence.

Former editor Seymour Reitman, now working as a planner in the Corps' South Atlantic Division at Atlanta, accepted the award at the Society's annual conference in Chicago. ■

Friendly Fred is "Top Dog"

Oklahoma's answer to Smokey the Bear is a fellow named Fred, the Corps of Engineers Tulsa District's pet prairie dog. Fred became a part of the Fort Supply Project family last September when employees set out to catch some prairie dogs in order to establish a colony within the recreation area near Fort Supply Dam. They wanted to preserve the little animals, now considered an endangered species in need of protection.

Thirteen of the burrowing brown rodents they captured chose to stay in their new preserve. A 14th made a bee-line for the project office, where he proceeded to make himself at home. Someone called him "Fred," and the name stuck.

Fred feeds on a diet of grass, but will turn his back on the grass in order to indulge in his favorite beverage, grape soda pop. His home is a roomy wire mesh cage in the project office. However, he roams over the entire room, checking out the trash can for any newly emptied pop bottles and just in general looking over anything of interest as prompted by his lively prairie dog curiosity.

From the first, the small animal showed he was cut from somewhat different cloth than his companions. Unlike the others, he chose not to sink his teeth in the project manager's thick gloves. He insists on being held and petted, and particularly enjoys having his back scratched.

Workers at the dam say Fred is the office pet, but an independent observer decided Fred has higher aspirations and is currently giving Park Manager Earl "Vic" Rodkey a neck-to-neck run for the title of "top dog."

A feminine newsperson visiting the office was taken aback (to put it mildly) when Fred reverted to early training and mistakenly confused a pants leg for a prairie dog tunnel.

In the meantime, Fred's popularity continues to grow. Accompanied by Vic Rodkey or other Corps personnel, he makes frequent appearances at schools, 4-H Club and Scout meetings, and before environmental groups. On these visits Rodkey talks about "The Prairie Dog" and shows a film, "Little Animals of the Prairie." Fred makes a hit by appearing every bit as interested in members of his human audience as they are in him. He has been the subject of many newspaper write-ups, some with pictures for which he happily posed, and he has starred on TV programs.

As soon as interest in the friendly little creature dies down, Fred will be returned to his own kind, Rodkey says. The new dog town is near the dam, and chances are Fred will find plenty of friends who will stop by to share a grape pop now and then, or perhaps take time to scratch a fellow's back. ■

SCSA Publishes Waste Management Proceedings

The Soil Conservation Society of America has published "Land Application of Waste Materials," the proceedings of a national symposium held in March 1976. This 320-page, softbound volume is designed to be a basic reference for research, practical management guidelines, and design of new treatment facilities and methods to solve pollution problems.

Twenty-two papers of some of the Nation's leading researchers are presented. They review the management aspects of using wastes to enhance plant growth without damaging land resources. These papers also summarize research in such areas as consideration of soils for accepting wastes; disposal of agricultural, silvicultural, municipal and industrial wastes; sediment as a waste product; and economics of land disposal systems. Included is a review of unresolved waste management problems.

"Land Application of Waste Materials" can be obtained from The Soil Conservation Society of America, 7515 Northeast Ankeny Road, Ankeny, Iowa 50021. ■

Cooling Wastewaters

A team from Penn State is researching an unusual new method for cooling power plant wastewater. Their idea involves creating a reservoir of ice, perhaps more than 100 feet thick, from water sprayed during cold winter months. The ice block would be used throughout the following summer to dissipate heat in the water that cools the power plant condensers. This would allow the wastewater, mixed with melt water, to be recycled back through the plant for more cooling. ■

The Games Students Play

Students at colleges in Michigan, Oregon, New York, Ohio, Pennsylvania and a university in Germany are using four computer-based games, designed by two Michigan State University professors, to learn about environmental trade-offs.

The games are based to some extent on actual environmental data and relevant research. Students spend 2 to 3 hours, in 30-minute blocks of time, on each game to increase their knowledge of alternatives in management of water quality, allocation of energy, operation of farms and feedlots, and control of agricultural pests.

To play "WAQUAL" (Water Quality), for instance, students can elect to be manager of a municipal water plant, a government agent in charge of compliance with pollution standards, or the owner of a bathing beach downstream from the treatment plant. They can add in a "clean-up" tax and work out water quality management methods according to different seasons of the year. The objective is to meet government standards in a cost-effective way.

At Michigan State University, the games are used in an interdisciplinary environmental systems course that is taught each fall. The water quality game also is used regularly in a civil engineering course. Each game provides an increasingly complex set of ground rules, and the student can choose to work with them at appropriate levels of difficulty. ■

National Wetlands Inventory

The stationing of coordinators at each of the U.S. Fish and Wildlife Service's regional offices marks another step in the operational phase of the national wetlands inventory. Conducted by the Service's Office of Biological Services, the main office of the project was established last fall in St. Petersburg, Florida.

The inventory is scheduled for completion in 1980. When finished, it will have produced a national wetland inventory map series, a computer data bank from which information can be retrieved and manipulated into either tabular or map form, and national and regional summary reports. The Service is collecting a vast amount of collateral material such as field reports and new aerial photographs and plans to make it available, on a limited basis, to interested organizations.

During the pre-operational phase the Service surveyed existing wetlands inventories; compiled an atlas of recent, high quality aerial photography; and produced a series of 468 maps delineating the ecoregions, physical subdivisions and land surface forms of the 48 contiguous States. These pre-operational products are available, on a limited basis, at the National Wetlands Inventory office, 217 Dade Building, 9620 Executive Center Drive, N., St. Petersburg, Florida 33702.

The current inventory differs from the last one, taken in 1954, in several ways. Since that project, a great amount of wetlands modification has taken place. While the earlier operation covered only the lower 48 States, this inventory includes all wetlands in the 50 States and the Territories. A better methodology now exists for classifying and inventorying wetlands resources, and a new classification system has been developed for this project.

The old, horizontally organized system identified 20 types of wetlands, all assigned equal stature. The new system has a hierarchical structure which will enable individuals to easily find the level of detail desired. It progresses from ecological systems at the general level to classes, subclasses and dominance types at the most specific levels.

Both public and private groups will be able to apply the new inventory data to many areas of their programs. The U.S. Fish and Wildlife Service and other government agencies, such as the Army Corps of Engineers and the U.S. Forest Service, will find the completed inventory particularly helpful in identifying critical areas of national wetlands for protection and maintenance. ■

What Is Cloud Seeding?

The present drought in the United States brings renewed interest in weather modification. One of the techniques being tried to produce rain and alleviate drought is cloud seeding.

Cloud seeding is the introduction of materials, such as dry ice, silver iodide or ammonium nitrate, into clouds. The purpose of cloud seeding may be to produce precipitation earlier than it would occur without the seeding, to increase the amount of precipitation or to produce precipitation from a cloud which is too small to produce precipitation naturally.

Clouds may be seeded either from the air or from the ground. Airplanes are used to drop dry ice down into clouds, to release silver iodide and ammonium nitrate from below clouds and to release materials while flying through cloud formations. The materials released from below are then lifted up by air currents. Seeding may be done on the ground by generators which vaporize seeding material into minute particles, which then rise into the clouds.

The seeding materials most frequently used are classed according to whether they are hygroscopic

materials (which readily absorb moisture from the atmosphere) or ice nuclei. Hygroscopic materials alter the coalescence process in the warm part of the cloud. Ice nuclei enhance nucleation in the supercooled (below 32° Fahrenheit but with no ice crystals) part of the cloud.

Basic assumptions of the cloud seeding technique are that at least a portion of the treated cloud is supercooled, that nature is not producing any or enough ice at that temperature of the cloud, and that treatment with chemical agents or refrigerants will change a proportion of the cloud to ice. Since the resultant mixture of water and ice is unstable, there is a rapid deposit of water vapor on the ice and a simultaneous evaporation of water from the supercooled droplets in the cold part of the cloud. This forms ice crystals. When heavy enough, these crystals fall as snow but may melt before reaching the ground.

Warm cloud seeding primarily tries to provide the large droplets necessary to start the coalescence process in clouds where insufficient large drops exist. In general, this method causes the liquid water naturally present in a cloud to precipitate out. Because the ice crystal seeding process also creates a release of latent energy, it may result in a more intense storm, greater cloud growth and additional precipitation.

Past experiments with cumulus cloud seeding in South Dakota, Florida and Missouri have shown indications of potential success. However, in the Missouri experiment added rainfall resulted only on days when there were moderate-size cumulus clouds. An overall rain decrease resulted from the random seeding of all summer convective storms, which produce most of the warm season rainfall. (Convective storms are those which transfer heat or other atmospheric properties by massive motion, usually upward.) The South Dakota experiment increased area rainfall on days when there were small convective storms but not when there were large convective clouds, for an overall rain increase of 10 percent. The Florida experiment resulted in greater rainfall from both single and merged clouds; however, no increases occurred on days when at least 50 percent of all warm season rainfall occurs.

These experiments indicate that rainfall could probably be increased on days when there are small isolated convective storms and not much rain is being produced. However, rainfall could probably not be increased to any great degree over a large area on days with sizable clouds and major natural rain production.

Washington State, hard hit by the drought, conducted cloud seeding experiments this spring and ran up against an unusual problem. Idaho accused Washington of stealing clouds, a new twist on the age old disputes over water rights. Despite these disputes over cloud ownership, cloud seeding shows promise of successfully alleviating future droughts. ■

Changes of Command

Major General Robert C. Marshall became the Division Engineer, Lower Mississippi Valley Division, and President, Mississippi River Commission, in Vicksburg, Mississippi on July 1, 1977. Before this appointment, General Marshall served 11 months as Deputy Chief of Engineers in Washington, D.C.

General Marshall's experience in water resources management included 2 years with the District office at Philadelphia, Pennsylvania; 3 years as Assistant Director of Civil Works, Office of the Chief of Engineers, Washington, D.C.; and 3 years as District Engineer at Mobile, Alabama.

He replaced Major General Francis P. Koisch who retired.

Major General Ernest Graves, former Director of Civil Works, Office of Chief of Engineers, Washington, D.C., was named to the post of Deputy Chief of the Army Corps of Engineers. He assumed his new duties on July 1, 1977. General Graves replaced Major General Robert C. Marshall.

Serving as the new Director of Civil Works, Washington, D.C., is Major General Charles I. McGinnis. General McGinnis arrived in Washington from Dallas, Texas, where he served as Southwestern Division Engineer.

On August 1, 1977, Major General James A. Johnson became North Atlantic Division Engineer. He succeeded Major General James L. Kelly, who was reassigned to Fort Belvoir.

Brigadier General James C. Donovan was named Southwestern Division Engineer with headquarters in Dallas, Texas, on July 1, 1977. He succeeded Major General McGinnis.

Several new district appointments follow:

Colonel George A. Bicher, Huntington, April
Colonel Robert M. Bunker, Far East, Korea, April
Colonel Rayburn L. Williamson, Saudi Arabia, Riyadh, May
Colonel William W. Brown, Charleston, July
Colonel Adolph A. Hight, Wilmington, July
Colonel Robert K. Tener, Nashville, August
Colonel John M. Adsit, San Francisco, August ■

The More The Merrier

More people visited Corps of Engineers recreation areas in 1976 -- 392 million visits were recorded -- than ever before. These lakeside areas have long been popular with picnickers and boating and fishing enthusiasts. They are becoming increasingly attractive to campers, possibly because most of these areas are located within 50 miles of cities with 50,000 or more residents.

This year, the Corps is operating 577 camping areas in 28 States. In line with Federal legislation, the Corps is required to collect camping fees at all its projects having certain federally provided facilities. Fees range from $1 to $4 for these areas, which must have such amenities as tent and trailer spaces, fireplaces, drinking water, electrical hook-ups, visitor protection and toilets. Holders of "Golden Age Passports" (62 and older) receive a 50-percent discount.

Free camp sites are maintained by the Corps at all its camping areas. They are rather primitive but do have access roads and contain sanitary facilities. ■

Coming Events

Fifth World Underwater Conference at Brisbane, Austl., September 10-13.

National Waterways Conference at Kansas City, Mo., September 14-16.

American Society of Landscape Architects at Minneapolis, Minn., September 25-29.

National Recreation and Park Association at Las Vegas, Nev., October 2-6.

Society of American Foresters at Albuquerque, N. Mex., October 2-6.

Sixth Annual Wild Goose Association at Corvallis, Ore., October 12-14.

Pacific Coast Symposium at Seattle, Wash., November 2.

2nd Annual International Symposium on Dredging Technology at Texas A & M University, Bryan, Tex., November 2-4.

3rd Annual Coastal Society Meeting at Seattle, Wash., November 3-5.

American Petroleum Institute at Houston, Tex., November 14-15.

The International Conference on Water Pollution Control in Developing Countries in Bangkok, Thailand, February 21-26, 1978.

National Wildlife Federation Annual Meeting at Phoenix, Ariz., March 16-18, 1978.

North American Wildlife and Natural Resources Conference at Phoenix, Ariz., March 18-22, 1978.

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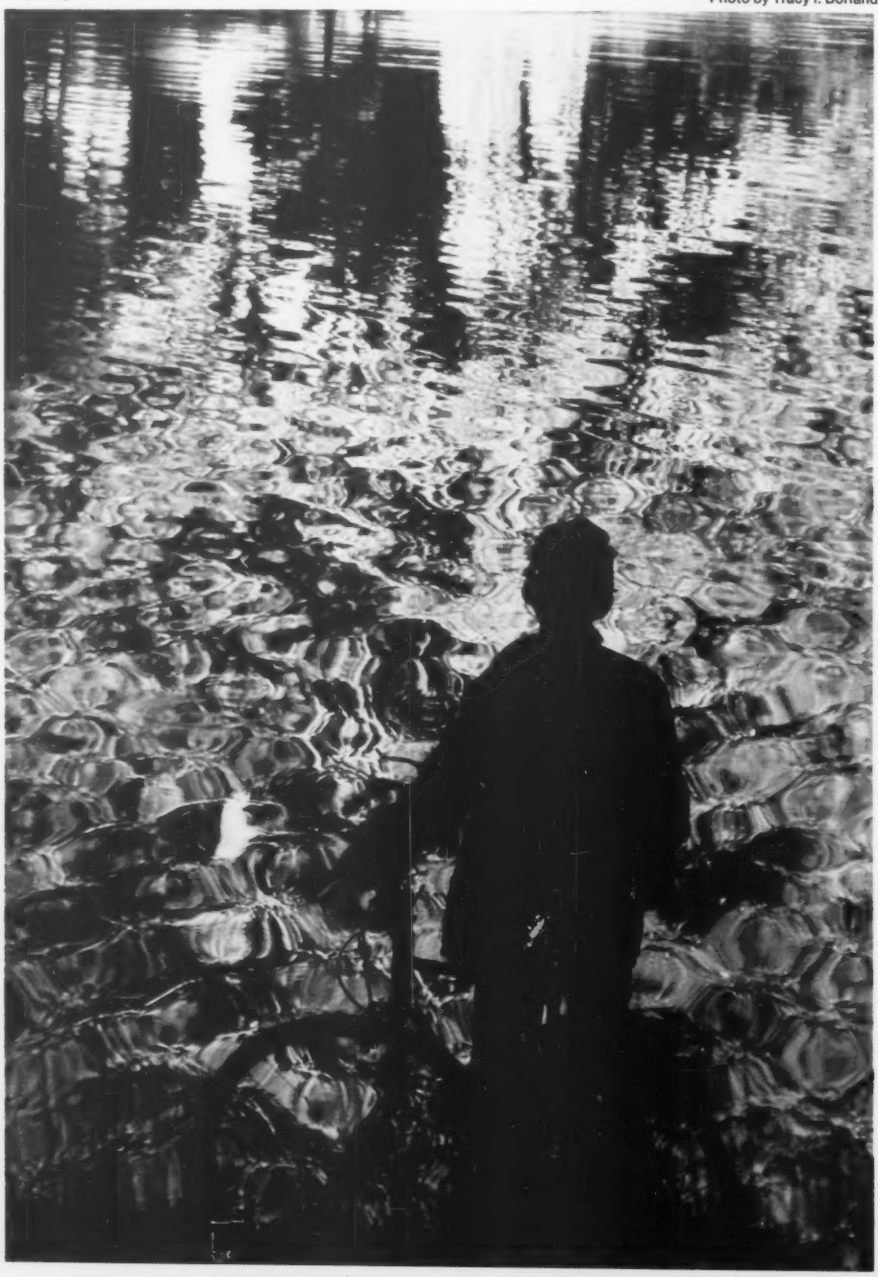
Photo by Tracy I. Borland



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